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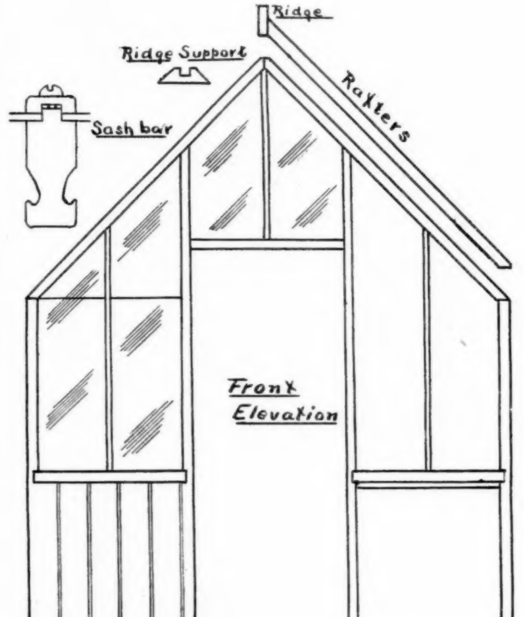
A PORTABLE CONSERVATORY.

GEORGE S. KINGMAN.

Lovers of flowers who desire to indulge in their pastime of gardening during the winter months, and are deterred from doing so because of living in a rented house and so object to erecting a permanent building, will find the portable conservatory here described both useful and satisfactory. It can be cheaply constructed and the cost of maintainance will be very little; in fact, it can be made a source of considerable revenue by any one desirous of raising flowers for local sale.

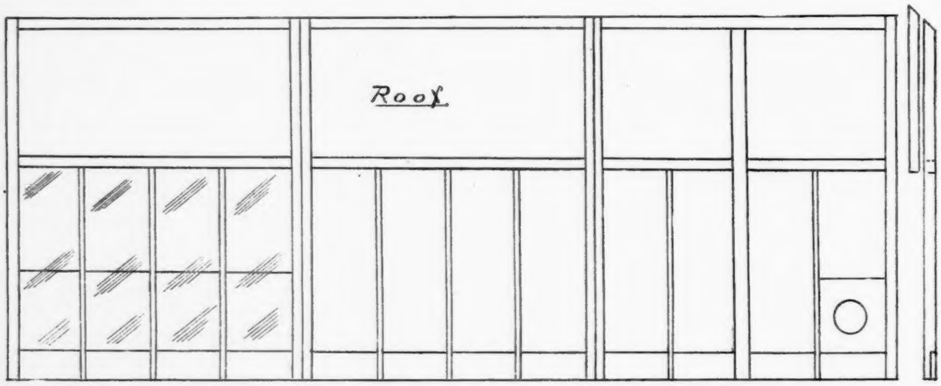
Should the portable feature not be required, a permanent structure can easily be adapted from the drawings, the changes being slight, consisting principally in leaving out the extra timbers required when made in sections.

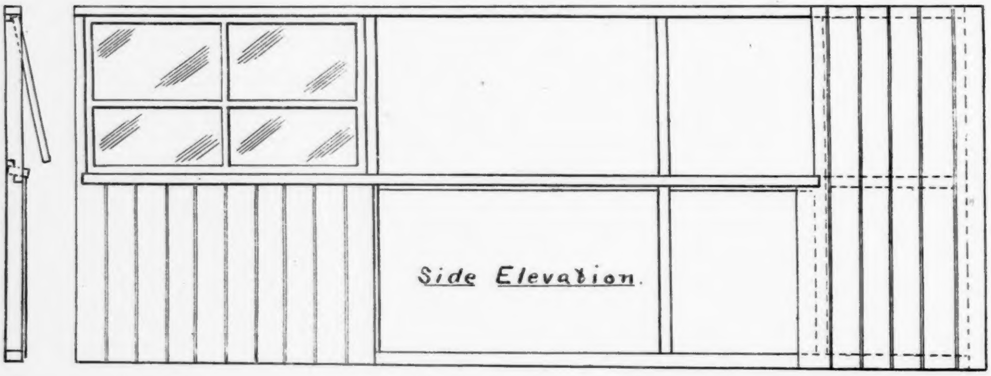


Before beginning construction it will first be necessary to decide upon the location, and the end in which is to be located the heater, unless the heating is to be done by pipes taken off the heater used for the dwelling house. Ordinarily a conservatory of even span is

located with the length running north and south with the heater in the north end, but it may so happen that while this direction is retained the heater may have to be placed at the south end. In such a case the sheathed end is placed at the south and the door at the north end.

cost about $75 without heater or piping. A small hot-water heater, expansion tank, and piping will cost $30, or if second-hand pipe can be obtained from a building being torn down, this item will be reduced slightly. All the lumber is planed all over except the first item, which is for the foundation.





If the occasion requires the houses to be run east and west, a design having a three quarter span roof to the south, and one-quarter to the north would be preferable, and the heater would be located in a northerly corner. The bill of materials required for the design given, 45 ft. long and 8 ft. wide, is as follows:

48 ft. 4 x 6 in. spruce, rough stock.
48 ft. 2 x 3 in. spruce, planed.
15 ft. 2 x 6 in. " "
300 ft. 2 x 3 in. " "
400 ft. ¾ in. cypress sheathing.
120 ft. 1½ in. cypress sash bar with deep gutter.
120 ft. cypress sash bar for ends.
70 pieces, single glass 13½ x 21 in.
8 " " " 15 x 34 in.
4 window sash, with 4 lights 13½ x 26 in.
1 door 50 x 66 in., upper panels glass.

Also, a roll of thick sheathing paper, having no tar, lead paint, nails, hinges, etc., which altogether will

In beginning construction, the first thing is to cut out two pieces of 4 x 6 in. timber 15 ft. 6 in. long, and two pieces 8 ft. long. The shorter pieces have tenons cut on the ends to joint into the longer pieces. When this is done, dig a shallow, level trench in the ground, in which to lay the timbers.

The sides may next be made from two pieces 15 ft. long and five pieces 5 ft. long, or 2 x 3 in. timber. As this stock is planed it will actually measure only 1¾ x 2¾ in. In the shorter pieces cut tenons to joint into the long pieces. The spacing between the first, second and third timbers is 4 ft. 9 in.; between the third, fourth and back pieces 2 ft. 5 in. Between the front and fourth timbers and 2 ft. 10 in. above the bottom piece, put a piece 12 ft. 5 in. of 2 x 4 in., halving the joints with the second and third timbers. This piece is given a slight slant outward, to shed rain water, as it forms the sill of the side windows. The ends are carried by the uprights, as with any window sill,

and the outside edge projects 1¾ in.

On the under side of this piece and flush with the edges of the uprights, nail a piece of 1½ x 2 in. stock, the upper edge being cut at an angle to fit under the sill and have the front edge vertical. This stock can be cut from 2 x 3 in. stock with a rip saw. Cover the frame under the sill and at the sheathed end with sheathing paper, and then put on the sheathing. Begin at the sheathed end and have the first piece lap over 3⅝ in., so that the joint with the end section will be tight. At the front end a similar lap should be given for the front end. The piece covering the fourth upright should be cut to fit flush with the front edge of the upright.

The front is next to be made. The bottom piece is 7 ft. 11 in. long; the two corner pieces 6 ft. long; the two roof pieces 4 ft. 8 in. long of 2 x 3 in. stock. The two pieces on either side of the door are 8 ft. 4 in. long, 2x4 in. stock, set outward 1 in. The piece above the door is 30 in. long. All joints are mortised. Between the door and ends are placed pieces of sash bar, and also above the door, after putting in cross pieces of 2 x 4, set at an angle as on the sides. The sheathing paper and sheathing is put on as before mentioned.

The rear end, being sheathed all over, is framed up about as for the front, with the exception that in place of the door, a cross piece of 2 x 3 in. stock is put across level with the tops of the end pieces, and another piece 3 ft. above the bottom piece. A sheathed partition at the heater end is framed the same as the front.

The frames for the roof are next in order; five of them being alike and one having a galvanized iron opening for the heater pipe, as shown in the illustration of the roof. This frame, as well as the corresponding one on the other side of the roof, has wide center division pieces, which cover the top of the sheathed partition. These frames are made up of end and ordinary sash bars, excepting the lower sides, which are of ⅞ in. board, 4 in. wide, halved on the under side of the sash bar. The upper face of the board is made even with the rabbets in the sash bars, which allows the glass to rest flat upon the board.

The glazing is all to be done with butt joints whereever any occur, as will be described later. The upper part of the roof frames are to be fitted with ventilators made the same way as the roof frames and hinged to the ridge. The dimensions of the roof frames are 6 x 4 ft. 10 in., outside dimensions, and the ventilator frames, 4 ft. 10 in. by 2 ft. 7 in., which allows for bevels on the upper sides to fit the ridge. The sash bars are spaced to receive glass 13¾ x 21 in. in the roof frames, and 13¾ x 26 in. in the ventilators.

These parts being completed, they may be erected and fastened together as follows: The sides and ends are fastened to the foundation timbers with 3 x ½ in. lag screws, boring holes for same and putting washers under the heads of the lag screws. The corners are fastened with three 2 in. angle irons; one each at the top and bottom and one at the center. Where the side sheathing laps, the ends fasten with 2 in. galvanized wood screws countersinking the heads. It should have been mentioned that a pot of white lead paint should be at hand during all the work, and every mortise and joint liberally coated with paint when finally assembling the parts.

The ridge pole is next to be fitted; it is 15 ft. 10 in. long. of 2 x 6 in. stock, and rests in saddle pieces nailed to the inner peak of the ends. The shape is shown in the end view, and the ridge is cut out 2 in. on the lower corners to pass over the peak of the ends.

Mortises are cut in the ridge and top pieces of the sides for two rafters on each side, 5 ft. 10 in. long and 2 x 3 in. stock. They are fastened in place with two 2½ in. screws at each end. It will also be advisable to put two 2 x 3 in. stringers across from the sides to hold the latter firmly in place during the erecting of the building. The roof frames are fastened to the ends, rafters, sides, etc., with angle irons and screws. The joints between the roof frames are covered with ⅞ in. battens 2½ in. wide, fastened with screws, and wider pieces over the joints at the ends. It will be necessary to fit pieces on the ends to bring the height equal to the frames before fitting the end battens, which should all be coated with lead paint when put on.

The door case is made with strips of ⅞ in. stock, 1½ in. wide, nailed to the timbers and set in ½ in. Similar strips ⅞ x 1 in. are nailed around the timbers on the sides where the side windows are located, the strips being inside the windows, which swing outward. The lower pieces must be beveled to the slant of the sill.

The plant stands are made separate from the building, being ordinary table frame construction, with front strips rising 9 in. above the level of the tops, which are 30 in. high. The center aisle should be 30 in. wide. No directions are given for fitting the hotwater heater, as, unless one is quite familiar with such work, it would best be done by a plumber. Good circulation is very important, and not to be obtained unless the piping is properly done.

The glazing is done last to avoid breakage. The "single" thick glass is specified in the bill of materials, but in localities where heavy hail storms are frequent, "double" thick will be advisable to avoid expensive breakage. When setting the glass, have at hand a smooth board upon which is a layer of white paint and putty, half and half, thinned with linseed oil to the consistency of thin paste. Press the edges of the glass into the mixture previous to setting. With nippers break off the lower corners of the glass to allow of ½ wire brads being driven into the sash, which will prevent the downward movement of the glass. Use diamond point glazier's brads, and coat the sash liberally with the paint-putty mixture before laying the glass using a flexible putty knife. Before and after glazing paint all the wood work with lead paint. The final coat may be tinted a light gray, if desired, and wears better than pure white.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

III. Four Cycle Engines.

Fig. 13 represents a section of a four-cycle engine of a common type. The working parts are very similar to those of the two-cycle type, but are further complicated by the addition of the valves and the means for controlling them. The piston, connecting rod and crank shaft remain as in the other type. The valves are controlled from the two lateral shafts *A* and *B*, which are run from the main shaft through the gears *c d e*. Since each valve only opens once for each two revolutions of the engine, the lateral shafts or cam shafts, as they are termed, must revolve only half as

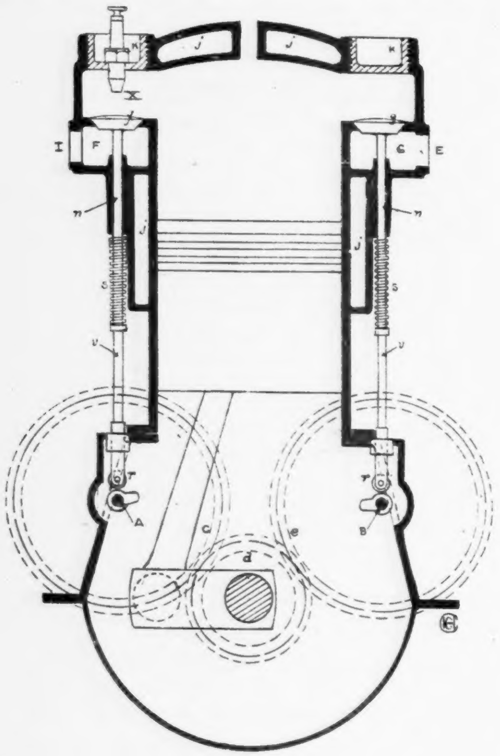


FIG. 13.

fast as the main shaft. For this reason the gear *d*, on the main shaft is only half as large as those on the two cam shafts. These cam shafts run in bearings in the base, and carry small cams or tappets, which strike the lower ends of the stems at the proper time and thus raise the valve from the seat. *F* is the admission chamber opening into the cylinder above the valve *f*. *G* is the exhaust chamber containing the exhaust valve *g*.

The valves have stems extending down through the casing in bearings to a point where they can be raised by the cam. The lower part of each stem is made square as shown, to form a guide, and the lower end is provided with a roller *r*, to reduce the friction. The square portion may be made a separate piece, with the valve stem just resting upon it; this facilitates the removal of the valves and stems, as the square guiding part will remain in place. At *ss* are coiled springs on the valve

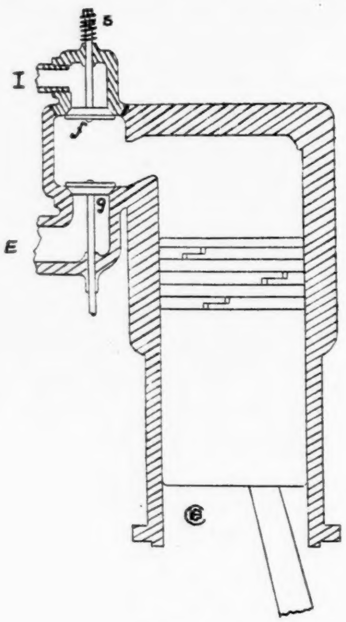


FIG. 14.

spindles to return the valves after being raised by the cams. At *k k* directly above the valves are plugs, either bolted or threaded in place, which, when removed, allow the examination or removal of the valves.

The cylinder and head is surrounded by the usual water jacket, *j*, which also, as far as possible, surrounds the valve chests. In the particular style shown the head is cast with the cylinder, but it may equally

well have the bolted head. The base in this type is made more ample and easier of access, as size is of little moment, and it is not necessary that it should be air tight. The sides of the base are covered with plates to keep out dirt and prevent the splashing of oil. *I* is the admission port where the vaporizing device is attached, and *E* is the exhaust opening for the connection of the exhaust piping.

The sparking device is located at *X* and the engine is also provided with the usual compression cock, lubricator drain cocks, etc., as before described.

The devices for timing the electric igniting spark and driving the pump are also controlled from the cam shaft.

The long sleeve tube bearing around the valve stem at *n* is provided to form a guide for the stem, and also prevent the escape of the gas from the chamber out along the rod.

The sides of the base are enclosed by plates which may be easily removed for examination, exposing the entire base. These plates are swelled out around the cams and rollers.

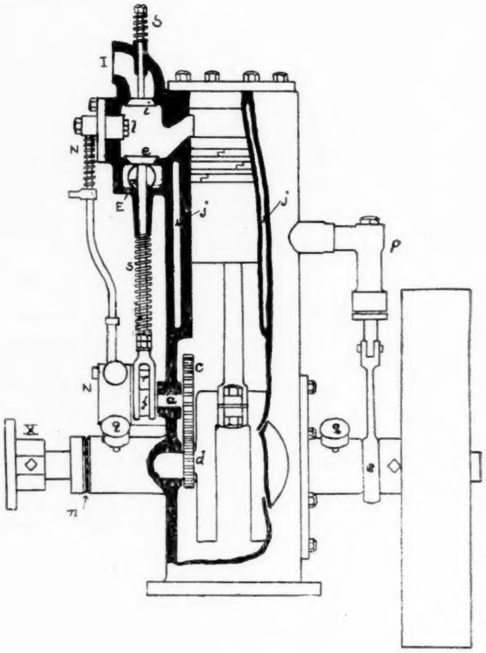


FIG. 11.

The gears *c*, *d*, *e*, are usually placed on the front of the engine with the gear *d* on the main shaft just behind the flywheel and the others just outside the main casing; they are then provided with a separate casing.

Referring back to Fig. 4 it will be plain that the suction of the piston on its down stroke will have a tendency to raise the inlet valve and allow the admission of gas. It is thus evident that is not entirely necessary that the inlet valve should be mechanically controlled, but may be left to be operated by the suction of the piston. The exhaust valve, however, as will be seen by referring to Fig. 7, must be raised against the pressure in the cylinder, so that it must be mechanically operated. Fig. 14 shows the relative location of the valves when this arrangement is adopted.

I is the inlet opening, *f* is the inlet valve, inverted in this case and held in place by the coiled spring *s*, although, of course the pressure in the cylinder will tend to hold it and press it closer against its seat; *g* is the exhaust valve, as before. This arrangement may be either on the side or the ends of the engines. This arrangement is, of course, simpler, as it dispenses with one cam shaft, and the accompanying gear. The question as to whether both valves should be mechanically operated, is much disputed at present, the representative builders being divided upon it in practice. It may be said, however, that while for slow or medium turning engines the suction inlet valve works well, for high speed engines the mechanically controlled inlet valve is preferred, as it acts quicker and more regularly.

Fig. 15 shows a very common arrangement for single cylinder engines; the valves are on the back of the engines. The exhaust valve is operated by the short cam shaft *a*, which is driven by the gears, *c d*, the gear at *d* being, of course, half the size of *c*. The inlet valve is operated by suction. To get at the valves the portion of the casting containing the inlet valve is removable, thus making both valves accessible.

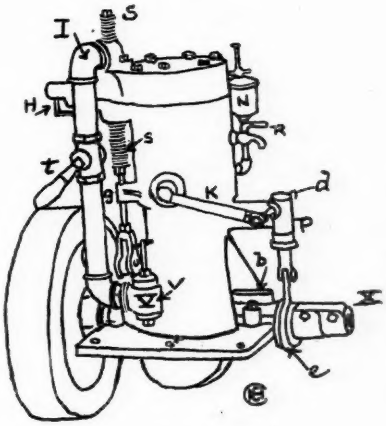


FIG. 16.

The flywheel, crankshaft and connecting-rod are of the same type as those already discussed, with the exception that the cranks are extended across the shaft and are broadened out to form counterbalances, to partially balance the weight of the crank pin and connecting rod, thus somewhat lessening the vibration.

The cam shaft is at a and is driven by the two gears, c and d. The exhaust valve G is actuated by the roller r and cam f on the cam shaft a. The inlet valve F is held up in place by the spring S. The inlet port leads in above the inlet valve; E is the exhaust outlet. The igniter gear N is also actuated by the cam shaft. At P is the cooling water pump, run from the eccentric e. The ball thrust bearing is at n. The coupling X, in this case is of the flanged type, the propeller shaft being furnished with a similar coupling, the two being held together by bolts through the flanges, each part of the coupling being fastened to its shaft by set screws or keys.

It will be noted that the cylinder, valve chest and base are a single casting, the head being bolted on, and the main bearings being contained in separate flanged castings bolted on to the sides of the base. The flange for bolting the engine to the bed, in this particular engine, is at the extreme bottom of the base, instead of about at the line of the shaft. The cylinder and valve chest are surrounded with the usual water jacket j. A grease cup gg is for lubricating the main bearings. The cylinder is provided with the usual compression cock and oil cup, which are not shown.

The gears c, d being inside the base, are well lubricated by the splashing of the oil by the cranks, and are less noisy than when outside the casing. The sides of the base are provided with round hand hole plates, a portion of which is shown.

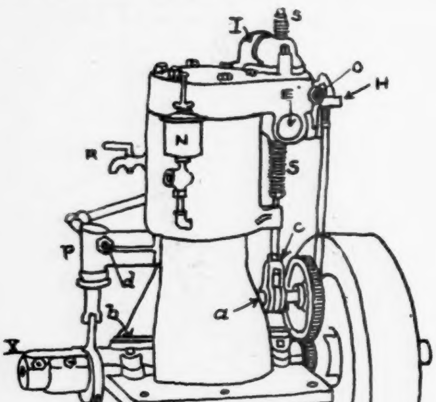


FIG. 17.

Two views of a representative small motor are given in Figs. 16 and 17. The cam shaft is located at a and is driven by the gears which are shown just in the rear of the flywheel. At c is the cam and roller which actuates the exhaust valve. The cam consists of a collar with a flat projection or toe upon its surface; the roller rests just above the surface of the collar, and is forced upwards by being struck by the projection. The roller is inserted to lessen the friction by rolling instead of rubbing. The valve stem extends upward into the valve chamber, and is encircled by the coiled spring e; the stem is guided by the guide at g. The exhaust is at E; I is the pipe leading from the vaporizer V to the inlet port in the valve chest. The inlet valve is directly below the spring S and is inverted, being held in place by the spring. The dome shaped cap containing the inlet valve is removable for access to both valves. The complete cover is also removable.

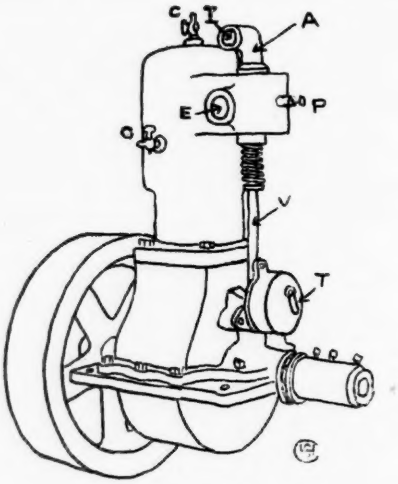


FIG. 18.

It will be observed that this engine has an open frame very similar to that of a steam engine, giving free access to the crank-pin and main bearings; the latter are shown fitted with oil boxes b instead of the grease cups, as there is no pressure tending to force the oil out along the shaft as in the two-cycle type. This open base not only makes the bearings, more accessible, but also renders it easier to lubricate them and keep them cool. At H is the ignition gear P is the cooling water-pump, run by the eccentric e The suction is piped to d and the pump discharges through the pipe k into the cylinder. The outlet for the cooling water is at O; N is the cylinder oil cup for oiling the bore of the cylinder. The compression cock R is for relieving the compression at starting. The coupling at X is for attaching the propeller shaft.

In this engine the cylinder, base and bolting flange are one casting, the upper half of the main bearings being removable for the insertion of the shaft. The cover is bolted on separately.

An engine of the light high-speed type, is shown in Fig. 18. The cylinder and valve chest are a single casting bolting on to the upper part of the base.

CONTINUED ON PAGE 276.

DEVELOPING NEGATIVES—FOR BEGINNERS.

Before starting development I arrange the following articles upon my table:

At the left-hand of the bench, as far removed as possible, is the dish containing the hypo. Laying beside it is a plate lifter, which is, of course, reserved for hypo only. In the center of the bench, right opposite the lamp, is the developing dish and graduated measure. Slightly to one side is a large box lid, which stands on end. Its use will be explained later. Close to it are my solutions, labelled "No. 1" and "No. 2." The "No. 1" bottle is nearer to hand than the "No. 2" one, because it is often necessary hurriedly to add some of the No. 1 to the developer, if the negative image is coming up too quickly; whereas there is always plenty of time to judge if it is coming up too slowly, and needs No. 2. Therefore I put No. 1 closer than No. 2. But whichever you do, always put them in exactly the same relative positions, so that the hand can find them instantly even if the light be poor. And as soon as you have poured some solution out of them, always return them to their proper place.

THE CAMEL'S HAIR BRUSH.

To the right of the bench stands a cup half filled with clean water. In it are a flat, broad camel's hair brush, and my second plate lifter. This plate lifter is reserved exclusively for developer. Whenever it has been dipped in the developer it is at once put back into the cup of water, where it soaks. The developer would dry on to it were it merely laid down on the bench. With the hypo plate lifter this does not matter so much, but the developer lifter should always be kept as clean as possible.

RUNNING WATER.

When all is ready, developer made up, etc., I turn on the faucet of my sink. It is kept running the whole time of development, but of course with only a slight stream of water. Then I rub a little toilet lanoline on my fingers, especially round the nails. This prevents them from staining, and keeps the skin from becoming chapped through being immersed frequently in cold water. In winter its use is especially recommended.

The red light is now turned on. The dark slide is opened and the plate lifted out, care being taken not to touch the film. Throughout all the operations the film of the plate should never be touched, as the lanoline might come off on it and make an oily patch partially impervious to chemical action.

DUST.

I do not dust the film before placing it in the dish, but gently puff upon it to blow off possible dust and specks. The plate is then put (dry) into the dish, which is held in the left hand. The measure-glass is held in the right hand, and the developer flooded on with one sweep, though not with such a strong rush as to spill any over the edge of the dish. As a matter of fact, a drop or two are almost sure to be spilled at some point of the proceedings, and for this reason the bench should be kept clear of all articles other than those in use. For instance, the dark slide should be put on a shelf or in one's pocket as soon as the plate has been taken out of it. It should never be put down on the bench lest it be wet.

The instant the developer has covered the plate, the dish and measure glass are put down on the bench again. I take the flat camel-hair brush from the cup, and, having flicked the water out of it, I pass the brush gently but firmly in parallel, overlapping strokes across the film of the plate. The object of this is to detach any air-bells which may have been formed on the film. The film is swept first lengthwise and then crosswise with the brush, which is then returned to place in the cup, where it soaks until required once more. Air-bells on the film are often so tiny as to be practically invisible; but the brush is a certain remover of them all. In any case, air-bells should never be detached with the finger, as some workers do. Always use the brush, and always keep it standing in a half-cupful of water while not in use.

AIR-BELLS.

If in doubt as to whether all the air-bells have been detached, pour the developer back into the measure for a moment or two, and inspect the surface of the film by holding it at a slight angle to the source of light. Any large air-bells will at once be visible. If any are noticed, the developer should be flooded on again, and the film brushed once more, though as a matter of fact, the mere flooding on of the solution will probably burst the air-bell.

The dish is now rocked gently to and fro. As little developer as possible should be used. Pour off all superfluous developer, leaving only just enough to cover the plate with a thin film of solution. Plenty of air should get at the film during development, though, needless to say, no part of the film should be left uncovered long enough to cause it to dry at all. If it is desired to increase the contrast in the negative, a good plan is to keep pouring the developer constantly in and out of the dish.

THE DEVELOPER.

It is hardly necessary to go into the question of over and under exposure. Obviously, if the image appear too rapidly, pour off the developer into the measure-glass and add some restrainer to it as quickly as possible. If it comes up too slowly, add accelerator. I use pyro-soda developer, and in the case of under-exposed snap-shots I usually put a little dry metol into my solution, with a little extra dose of the "No. 2" (accelerator). But it is always necessary to see that the dry metol is thoroughly dissolved before pouring it on

to the plate. Sometimes it cakes into tiny undissolved blobs in the measure-glass; but if thoroughly shaken for a moment or two, these disappear.

I recommend beginners to develop their plates one at a time, finishing each one before another is begun. Personally, I always have too many to develop to be able to afford the time to do them thus, so I develop two at once. As soon as one of them is fairly started, and I see that it is not coming up too quickly, I place a second one in a dish, pour developer on it and brush off air bells as in the first case. But previous to doing so, I place the dish containing my first plate a little to one side, so that it is in the shadow of the box lid which I mentioned at the beginning of these notes. This box lid stands upright on the bench, and casts a broad shadow. In no case should the dish be allowed to bask in the rays of a red lamp, however safe these may be supposed to be. After the solution has become a little discolored, the danger of fogging the plates is less; but even so, it is inadvisable, and really quite unnecessary, to leave it right in front of the lamp. As soon as plate number two has started off I take a look at number one. Then back to number two again; and so on, until one or both are finished.

WHEN TO STOP DEVELOPMENT.

A good way to judge whether a negative is sufficiently developed is to look at the back of the plate. All the outlines of the main objects should be distinctly visible through the glass on the back of the film.

When this is the case the plate is lifted, by the aid of the plate lifter, which is immediately afterwards returned to its cup, from the dish, rinsed for a moment or two under the running faucet, and then placed in the hypo. I at once wash my fingers under the faucet and dry them on a towel before returning to the development of another plate. It pays to be scrupulously clean. The fingers of a really clean worker never show a stain of any chemical.

I find a mixing tank more useful than a dish, and I can strongly recommend it to those who wish to develop a number of negatives at one time. When two negatives are developed almost simultaneously, as described above, one of them is almost sure to be only about half fixed when the other is ready to be put into the hypo. For this reason, two or more dishes of hypo should be prepared if the worker does not possess a tank.

THE HYPO TANK.

My tank is an ordinary cheap, tin one, and a rack to hold six plates fits inside it. Better still is a porcelain tank, but I find these too heavy for traveling, so use a tin one. Of course, a quantity of hypo solution must be made up and bottled for use. It can be used repeatedly. A further advantage of fixing plates in a tank holding six or a dozen, is that there is no fear of removing them from the hypo solution before fixation is complete, as sometimes occurs when it is necessary to fix one plate after another in a single dish. Curly films, too, are much more satisfactory in a tank where they can be stood upright than in a flat dish, where their edges often rise out of the solution.

When fixing is complete, the plates are transferred one by one, to the washing water. Each one is rinsed before being placed in the water. This is to remove any dirt or grains which may have become deposited on the film in the hypo. When the hypo has been in use some time it becomes muddy, and is apt to deposit a scum on the plates. If the plate is thoroughly rinsed under the faucet before being washed, this scum is at once removed; whereas it clings with wonderful tenacity if the plate is merely soaked.

A WASH UP.

As soon as the operations are completed, the dishes, measure glass, tank, brush and plate lifters are carefully washed and set aside to dry. The tank, after being washed, should be stood upside down to drain.

The main points to note in development are: Keep every object in its accustomed place on bench and shelves. Do not attempt to develop too quickly or to fix too quickly. Do not touch the surface of the plate. Rinse the fingers between each operation. Keep plate as much out of the reach of the light as possible. Be clean and systematic.—" Photo American."

WHY GROUPS ARE FAILURES.

WARD MUIR.

Probably the first problem on which the proud owner of a new camera tries his hand is a group. His family —and any chance friends who may be calling—are marshalled upon the doorstep, exhorted to look pleasant, and snapshotted to the accompaniment of facetious comments from passers-by.

Photographically nobody would deny that groups are, in most cases, a melancholy failure. As a source of amusement they will, however, never cease to be a success. Wherefore it is fitting that a few notes should be devoted to the subject. Folks will go on group-taking—notwithstanding the sneers of professionals and the weary protests of the victims—to all eternity; and the craze may as well be catered for.

Groups are generally taken under a misapprehension. The photographer seems to imagine that the aim of his labor is to provide likenesses of the "groupees"; and that, by taking half a dozen people on one plate he proposes to produce half a dozen portraits.

This theory is a fallacy. The object of taking a giv-

en set of half a dozen people at once is not primarily that of portraiture, but (though this at first seems a trifle exaggerated) that of historical record. The camera is utilized for the purpose of making a note of the fact that on a certain date certain friends were gathered together in a certain place. The proof and memorial of this occurrence is the photographic group.

Of course, if the individual faces of the group are satisfactory likenesses, all the better. But they never are, for the simple reason that they appear too small, and therefore almost impossible to retouch. And there are so many of them that some are almost sure to be bad.

No; groups are not wholesale portraits. The photographer who gets this idea out of his head will have gone a long way towards improvement. Why? Because once you realize that groups are records of the presence of given people in a given spot, you cease the atrocious habit of posing them unnaturally. You begin to perceive that the real reason why your groups were a subject of merriment was because they were so artificial looking. When friends meet, they don't squash shoulder to shoulder upon the cold, hard doorstep, nor do they habitually mass themselves in a clump of humanity under the back-garden laburnum tree. They stroll about, chat, read, shake hands. Why then not photograph them in the act of doing so? Instantaneous shutters and rapid plates have made this quite possible. Why then shirk the experiment?

The most sensational picture at the 1903 photographic Salon was a group. Never before had a group been accepted at the premier exhibition of the metropolis. Then what was the special distinction which singled out this especial effort? Wherefore was Mr. Reginald Craigie, its author, honored above all the other aspirants to fame who doubtless had submitted groups to the critical judgment of the Hanging Committee?

Simply because Mr. Craigie's group was true to life. It represented the members of the Court of Directors of the Bank of England—an august body, who by the bye, had never before recognized the existence of photography as a historical recorder. Mr. Craigie might conceivably have taken them on benches in the bank's quiet little central courtyard, or he might have induced them to cab down in a body to the Camera Club and pose in front of a painted background in its studio. He was too good an artist to commit such an eggregious error. He let them sit around their board-room table exactly as they were accustomed to do at ordinary meetings. They were apparently caught in the act of deliberating some weighty question of finance. Not one of them is "conscicus." The result is a triumphant proof that the mere fact that a photograph is a group does not necessarily condemn it as a work of art. There is no jarring note in Mr. Craigie's photograph, there is nothing unreal about it; it doesn't make you smile. And the group which doesn't make you smile is sadly rare.

Mr. Craigie, too, has taught the photographic world that the composition of a group need not necessarily be wooden. The lines of his group are excellent, and so is the massing; and the light is soft yet natural.

Now reflect for a moment what the average snapshotter's group looks like. In ninety-nine cases out of a hundred it consists of three straight tiers of bodies topped by three rows of heads. The faces from a treble row of white blobs, hideous in their mechanical symmetry. A lower series of black blobs, in the shape of feet, repeat and accentuate this melancholy and irritating pattern.

This, I think will be admitted, is a fair description of the usual family group, as perpetrated by the amateur. The professional's is a little better. Papa and mamma are seated in armchairs. The youngest olive-branch nestles between papa's knees or lounges in undisguised comfort upon his feet. Sons and daughters lean over their parents' chairs or turn the leaves of old-fashioned albums. Not one of the whole group is at ease.

As portraits the result is negligible, owing to the smallness of the faces. Historically the thing is nothing more nor less than a lie; for never in heaven or earth did a family exist who honestly enjoyed such close proximity to each other's persons, or who from preference spent their time examining albums or leaning over the backs of their parent's chairs. Wherein then, lies the merit of the group at all?

As I have said above, groups if they are defensible on any score, are defensible as mementoes. That is to say, they stand or fall on the question of their truth to the actual state of affairs when they were taken.

Is it picnic you wish to record? Then catch your company while they are boiling the kettle or pouring out the tea. What does it matter if a few of the picnickers have their backs to you or if one of them is caught in the ungraceful act of eating bread and jam? The photo will recall that jolly holiday far better than a posed affair on an uncomfortable rock. Do you want to make a note of a garden party? Snap them in the middle of a game of croquet. Is it a cycling tour which you are immortalizing? Take them mounting at the inn door, or repairing a punctured tire by the roadside.

What a delightful history of the trifling events which go to make up one's life a series of such unposed groups would be. Let every camera owner make it his duty and pleasure to start compiling such a series at once. I warrant his little black box will cease to be a terror to relatives and friends if he adopts this scheme.—"Focus."

On a switching locomotive in Brussels, Belgium, instead of braking by means of shoes bearing on the wheel treads, the brake shoes are thrust down on to the rails, somewhat after the plan well known with cable cars.

SUMMER THUNDER STORMS.

FRANK P. SMITH.

The massive clouds, the vivid lightning and pealing thunder, the heavy rain and gusty wind accompanying the summer thunder storm, are manifestations of nature's forces which produce in our minds feelings of wonder, and to the timid are a cause of uneasiness and fear. A brief presentation at this time of the meteorological causes and effects of such storms will be of interest to readers of this magazine.

It is the summer thunder storm only which will receive our attention, many storms with lightning and thunder being the result of rather different conditions from the heavy summer storm. The latter is generally a comparatively local affair, travelling but a few hundred miles, or less, from the point of its origin. Many of the storms traversing New England States, originate in New York and have spent their force before or shortly after reaching the Atlantic ocean.

The formation of such storms begins generally in the morning of a hot day with a fairly high humidity. The heat of the sun causes an expansive upward movement of the moisture laden atmosphere which, upon reaching the cooler heights, is condensed into misty whisps of clouds. These nebulous beginnings increase in size until about noon, or soon after, they have reached a towering size and the cloud masses extend to a great height, and assume the so-called "anvil" shape of the well developed thunder storm.

This anvil shape of the clouds is the result of air currents which have developed coincidently with the cloud masses. The illustration shows a cross section of a thunder storm, as far as present day knowledge enables us to graphically represent the action taking place. The long arrows show the air currents, and attention is directed to the low, projecting undercurrents which denote the approach of the rain bearing section. The preliminary wind squall is probably caused partly by the cooling of the atmosphere lying within the shadow of the clouds, which has been deprived of the heat of the sun and further, by the air movement which results from the upward motion of the central air currents.

As the heated and moisture laden air rises in the center of the cloud mass, it eventually reaches the cooler region of the upper air, and condensation of the moisture follows and continues until minute droplets of rain are formed. These droplets unite to form larger drops until they are of such a size that their weight causes them to fall to the ground.

Should the intensity of the storm be sufficient to cause the air currents to rise to a great height, where low temperature prevails, the condensing moisture may form into snow flakes instead of rain drops, and the flakes, in falling to the warmer, moist air, will collect moisture on their surface, which will freeze in successive layers until the weight eventually brings them to the ground in the form of hail stones. It is thought that from the first condensation of the snowflake to the final fall as a hail stone, the air movement has caused the condensing moisture to rise and fall several times, this theory being supported by the formation of hail stones, which are known to be of several distinct layers, the number varying somewhat according to size.

So far, no mention has been made of the causes of the thunder and lightning, the latter being, it is almost needless to say, of an electrical nature. The atmosphere is known to be at nearly all times, of a differing potential from that of the earth, the latter being negative and the atmosphere of a positive charge. This difference is greater as the height increases, but is comparatively small in quantity and variation during pleasant weather. During thunder storms, however, the potential varies widely, and the charge may fluctuate from positive to negative and the reverse, but is generally of somewhat higher than normal potential and positive in character.

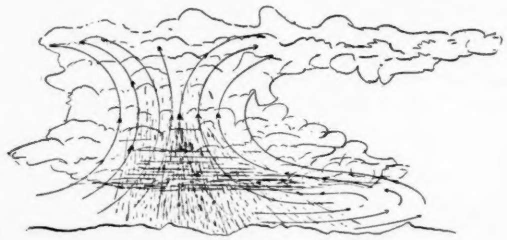
The moisture in the air is carried upward with the ascending air currents, and upon reaching the higher and cooler altitudes, condenses into raindrops. These raindrops undoubtedly become electrically charged upon their surfaces, and the potential of the charge increases as the smaller drops unite to form larger ones. When the magnitude of the cloud is considered, it will be apparent that these myriads of minute charges in the movement of falling, serve to give to the adjacent atmosphere a tremendous electrical charge, which, breaking down the resistance of the air, discharges to earth, for which it has an affinity by reason of its being of opposite polarity.

Hence the lightning flash or rather flashes, as what appears to the eye as one irregular flash is frequently several flashes or surges. Two or more flashes frequently unite near the earth to form one intense flash, the intensity and disruptive effects of which are familiar to all. The greater number of flashes do not reach the earth, but exhaust their energy in breaking down the air gaps between adjacent sections of clouds. The form of lightning having the appearance of flaming balls with comparatively slow movement, is not as yet fully understood, but may result from certain air currents which form a path for the electrical discharge.

The thunder results from the violent vibrations of the air caused by the lightning flashes, which in breaking down the resistance of the air, create a vacuum of an extent depending upon the intensity of the flash.

The air rushes to fill the voids thus caused, creating violent vibrations, which travel long distances, and do not differ in character from other sound waves, but are of greater amplitude than ordinary because of the greater forces causing them. The velocity at which sound travels is about 1100 feet a second, a rough approximation being five seconds to the mile; from which one may readily calculate the distance of the flashes.

What has been stated above is of a general character, and based upon the present knowledge of meteor-



ological conditions. Skilled observers in many sections of this and other countries have devoted much attention to the study of this interesting subject, and additional knowledge will undoubtedly be forthcoming in due time. The study of how to protect buildings from the disastrous effects of lightning is also being followed by scientific observers, and a more exact statement of how this may be accomplished will undoubtedly be available in the near future.

It has already been found that lightning rods, to properly serve their purpose, should have numerous sharp projecting points above the building; that these points should be well cross-connected with copper rods, making a sort of net-work, and that this network should have a number of conductors to earth. The earth end of the conductors should also be buried deep enough to be in permanent contact with moist earth, the essentials being to supply an ample path to the earth for heavy flashes. Single points on the roof. with rods direct to the earth and without cross connections, provide capacity for only the smallest discharges, and large ones, in seeking a path, leave the rod, with consequent liability to damage the building.

Should a person receive a shock from lightning, it frequently happens that respiration has stopped because of temporary paralysis. If assistance is at hand the usual methods for restoring respiration should be actively continued for at least an hour, the services of a physician being obtained as soon as possible.

RECLAIMING SAND HILLS.

Reclaiming the barren sand hills of the Middle West with forest cover, to supply timber when there is a dearth of it, is one of the more striking of the important forest planting projects of the Forest Service. Four of the National forests have been established in the non-agricultural region with the express purpose of getting a firm grip on methods which will overcome natural difficulties and set up object lessons for the benefit of the people. These are the Niobrara, the Dismal River, and the North Platte reserves in Nebraska, and the Garden City reserve in Kansas. The Nebraska reserves have responded so well to careful treatment that hundreds of thousands of seedlings have been planted out and millions more are being raised in nurseries for use in other reserves. Thus, for the first planting of the Garden City reserve, just completed, most of the trees were taken from the nurseries in the Dismal River reserve.

The Kansas reserve lies in a region of scattered, barren sand hills, interlaced with prairie on which grass thrives well enough to support live stock. The origin of these hills, in itself interesting, reminds one in a way of that of the sand dunes which encroached from the sea upon the fertile fields of western France and laid them waste. In both cases the wind has been the enemy of the soil, for in France wind drove the sand of the seashore inland, and in the middle-western region of our own country wind drove eastward the sand which the Arkansas river had carried down in floods and afterwards exposed to dry. The sand hills were formed long ago, and the action of the wind is now largely checked by the spread of the carpet of grass, which binds the sand wherever there is enough moisture to encourage it.

The semi-arid conditions of the region necessarily restrict the selection of trees. Right choice of species, the crux of forest planting generally, is here especially decisive. By its aid, together with right planting methods and right care of the plantation, a treeless region, one therefore in which wood is a scarce and a highly valuable commodity, can be made to produce useful woods, and at a cost so slight as to satisfy good business judgment. Thus on a light, sandy surface, whose only cover is wild grass and weeds, a merchantable forest crop is to be grown.

Honey locust, Osage orange, Russian mulberry, red cedar and western yellow pine are the trees used in the new project, of which 51,000 came from the Government nursery, near Halsey, Neb. The planting this season progressed under highly favorable conditions as regards weather and the physical condition of the soil, and at the expiration of six and one-half days thirteen men had completed the task at a total cost, exclusive of the trees, of \$3.88 per acre.

Of the various chemical substances that have been used with a view of rendering wood fire-proof a solution of silicate of soda has been proved to be the best. Wood painted properly with the solution has been found not even charred after long exposure to fierce flames.

SITTING ROOM FURNITURE.

PAUL D. OTTER.

Very little information need be given for this table, Fig 2, in the simple style. The plain posts and under framing are laid out on a drawing in a square of 21 x 40 in. having the posts center along two intersecting diagonal lines, the open or top rails being mortised into the posts about 4 in. under the edge of the top. All edges should be chamfered 3-16 in. and just above the taper of the posts treated to a saw kerfed line, also chamfered to give finish. The top should be careful y matched from 1 5-16 in. lumber. Allow for the height of the table 30 in. to the top either with or without casters. The weathered oak finish is undoubtedly best for this much used piece of furniture.

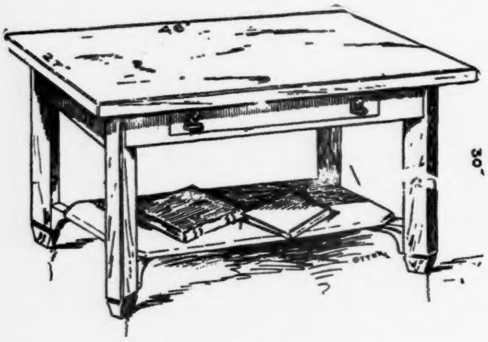


Fig. 2.—Sitting Room Table.

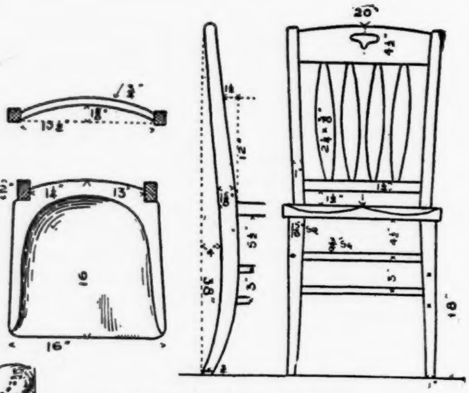


Fig. 5.—Details of the Side Chair.

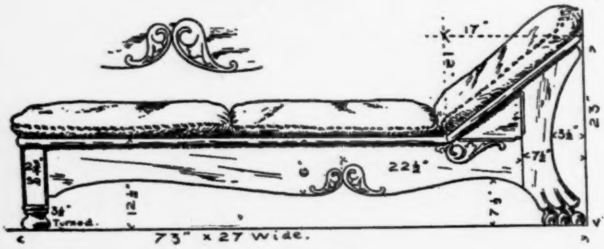


Fig. 3.—General View of Couch.

Fig. 4. –Method of Sewing the Leather Covers.

The couch should not be a difficult frame to construct. Indeed, after the inspection of the factory made article, the craftsman may, with a little practice with pencil and paper, lay out from observation a frame which will have a pleasing, substantial outline yet have the joints all cut square. With this thought Fig. 3 is presented with the necessary measuring memoranda given thereon. The frame is within a size of 27 x 73 in., making it ample in length for a "six footer," or generous enough for an overflow accommodation in the event of a surprise party. The head posts terminate in a claw foot, the main rails and foot rail are made of not less than 1 in. boards.

The shape given for head posts will come from a board 7½ in. wide. From a previously drawn detail showing the continuous character of line in its constructed form procure the separate marking out patterns, and right here be mindful that with the cut out paper pattern allow in the wood, in case of the line arching from claw post joint to the horizontal rail, an excess of stock which, when the parts are glued up, may be sawed or shaved to the correct free arching line. The union of parts in this way creates one of the pleasing features to attract the eye, and the eye following this line in fancy terminates in a foliated scroll as suggested, and the turn is met by a like but less forceful line springing from the foot post. In like manner, the inclination of head rest mold may have its abruptness folded up in a similar termination. The couch frame, of course, is to have the same treatment on the other side, for a one-side couch gives but one-half the number of positions in which it may be placed.

A little consultation with the wife will often save a man doing some foolish things, even as to furniture

for the housewife tires of seeing her possessions always at the same angle or on the same side of the room. The fullness of the clawfoot is made by gluing on a 2-in. block, the upper portion of which will, by sawing or shaving, invisibly shade in a natural manner into the post. As treated in a previous article no set directions can be given for cutting or carving this claw; the carved claw is very much in evidence, and, as in everything else, a careful inspection will aid materially in producing a good effect, even with the chisel or gouge in use by the carpenter. The claw as a termination is selected, for with the inexperience of an amateur in carving the necessary unevenness and roughness will, by contrast to plain parts, make a pleasing feature. A rough claw is better than if it were produced from a turning lathe, if that were possible. A pleasing effect, in place of carving the ornaments on the side of a couch, is to jig saw the patterns detailed from a 2-in. block, then by passing them along a set straight gauge slit them on the band saw into frets 3-16 in. in thickness. Glue these along the proper line and direction, and after sanding the edges a very pleasing form of relief will result.

The foot posts are 2¾ in. square, with the three exposed corners chamfered. A turned ball 2½ in. in diameter gives a finished termination. The head end rail, 6 in. wide, is placed in line with the side and foot rail, and then panelling or veneer occupies the space between that and the inclined frame. The molded effect along the upper edge of the head support and rails may either be a narrow framing surmounting the construction or a moulded strip secured as an after finish.

The form of upholstery shown in the cut is now very generally a part of the simple class of furniture and stands for just what they are—bags, made in a primative manner, filled with soft material. Here again the craftsman of today will be equal to the occasion and find little that requires special skill in making the cushions to fit his frames. Soft, pliable Spanish leather (sheep skin) in all colors may now be secured in many towns. Unnecessary expense may enter here as in everything else, and it would be well to make the selection by samples. The bottom cover piece may also be of the same color and grain imitation, but of pantasote or other substitutes for leather. Likewise, instead of upholsterers curled hair a half quantity vegetable down may be used. It will be quite necessary, as well as satisfactory to guard against waste and to find the exact size of leather, to make a sample cushion one-half size of the couch body—that is, divide the couch into three pillows, using some cheap material and cutting it ample to allow for pillow when filled to the width of the frame. The filling should not be less than 5 in. in thickness.

From this bag material, if made to fill up properly, the exact size of the leather covers may be found, allowing more on these for ½ in. to be turned in on all sides. This ½ in. extra is turned and pressed or hammered into a crease, and the two creases of the four edges of each piece are brought together, rough side in, then held for a time while holes are made with a belt punch about 1 in. apart. Through these holes, as shown in Fig. 4, a thong strip, cut from the leather, is drawn, and in the after finish a second thong may be drawn, inserted so as to produce a cross weave effect. One side of the bag is of course left open to receive the inner filled bag, or the filling may be put in direct and the thong continued through the holes and finally tied in a neat manner.

THE SIDE CHAIR.

This is a pattern in the modern style, appearing well as a wall chair or making a good, light chair for the table. The chair would be in keeping with the present primitive construction to have the back slats perfectly flat, but a more shapely and comfortable back will result by using curved back slats as indicated in *A*, Fig. 5. A flat panel is usually steamed and bent, but for special purpose the curve is produced from a heavy plank, using an adz, or in default of this a gouge and heavy mallet, and after shaving to curvature determined by a wood templet, used as the work advances. Much of the convex side can be planed to line and even thickness by holding the work in a vise. The back post shape may be secured from a 1-in. surfaced board. If oak is used, show the quarter grain on the edge.

In making the seat none but thoroughly seasoned stock should be used, and after the saddle effect is obtained it should not be unprotected by finish very long. As you will need a heavy cleat, or batten, screwed to bottom as a means of holding it in the vise while shaping the hollow, it would be well to keep it on during construction of chair and until time for finishing, avoiding chance of warping. The hollow work is roughed out by a gouge and mallet, and then convex shaves and scrapers are used to bring about an even concave surface.

After all parts have been fitted with tenons and mortises, assemble them to see that they all come together well, also to give you an opportunity to note corrections which might be desirable to make and the final finish to be given each part. With the chair knocked apart the edges are worked off with a plane or shave, and the four slats in the back are greatly improved with edges turned off to a quarter round, likewise top edge of top slat, and hand hole smoothly filed in a rounded manner. The back part is glued up first and held in bar clamps under the seat; two square stretchers should be fitted at the same position, as shown, for stretchers. The side stretchers are indicated on the front leg.

The seat is now set in, as shown on seat plan, and secured at each post by a 2½ in. screw countersunk. Turning the back part down, with seat face down on bench, put on the front portion of chair, the legs and front stretcher having previously been glued up, then

CONCLUDED ON PAGE 274.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

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AUGUST, 1906.

This is the season of the year when vacations are uppermost in our minds, and relaxation and out-door pleasures the order of the day. We know that many boats, built from descriptions published in these columns, are affording the builders much enjoyment, not alone from the pleasure of boating, but because the boats are the product of the owner's skill and workmanship. Descriptions of other boats are in preparation and will be published in due time. The first chapter descriptive of a thirty-foot auxilliary yawl will appear in the November issue, and as boats of this type and size are rapidly coming into favor, we are confident this description will be received with much interest.

While many readers may not actively engage in constructive work, the summer months afford an excellent opportunity for tours of investigation, and plans can be made for winter work. An enlarged staff of contributors enables us to promise some decidedly interesting articles in new fields, and those "who like to make things" will find the forthcoming issues of the greatest service.

A number of recent inquiries from readers, requesting advice as to the most helpful books on technical subjects, prompts us to state that we shall be most pleased to recommend books for purchase by anyone making inquiry, provided stamp for reply be enclosed with inquiry. Having a large reference library at our command, information regarding technical books can be given from personal knowledge of the contents of the best books to obtain.

Many readers are familiar with some tool, instrument or device, a description of which would be of interest to other readers of the magazine. We shall be pleased to hear from anyone willing to supply us with such descriptions, for which suitable payment will be made. To avoid duplication of subjects already in hand, or in preparation, it is advisable that inquiry be first made as to the probability of an article being accepted before same has been written. We can then state whether a topic would be acceptable, and perhaps assist in making same more nearly in accord with our needs. Think over what you have made or done out of the ordinary, and write us regarding same.

We want photographs of articles described in this magazine which have been made by readers, and will give a year's subscription, or any one subscription premium, for each accepted photograph of this kind. A brief description of the article, mentioning any peculiarities of the work, should accompany the photograph.

Although Davy's lamp is the model miner's lamp, it has been the subject of numerous modifications. The best-known systems are divided into two classes, according to the principles on which based. In some the flame is surrounded by a thin metallic gauze. Should any quantity of explosive gas enter the lamp through this gauze an explosion will only take place inside the metallic gauze envelope and extinguish the light without outwardly communicating fire. In others the light is produced by an electric current inside a tube or small bulb filled with extremely rarified gas. The breakage of the bulb instantly causes the extinction of the light.

AN EXPERIMENTAL THERMOPILE.

The thermopile is an instrument consisting of one or more pairs of dissimilar metals, in the form of wires, bars or blocks, joined together at one extremity. On applying heat to the junctions, an electric current is set up, the pressure and volume of which depend partly on the size of the surfaces in contact and partly on the temperature to which the junctions are raised.

Such instruments are extremely useful for the production of such small, steady currents as are required for grading delicate ammeters and volt meters; for registering minute variations of temperature, etc., in which case they are used in conjunction with a delicate galvanometer, the readings of which are known to correspond with certain amounts of current, and

FIG. 1.

consequently to given rises in temperature attained in muffles and similar furnaces, wherein no ordinary thermometer could be employed, since the heat would melt the glass and dissipate the mercury.

The two metals which have been more generally employed in the construction of thermopiles are antimony and bismuth, but as there are some little technical difficulties in making good junctions between the metals, he advises the student to commence his attempts in this direction by procuring two 6 in. lengths of No. 18 wire, one being of copper, the other of nickel. Having cleaned them nicely by rubbing with fine emery paper, he will hold them parallel to each other between the jaws of a vise. In order not to crush the wires it is advisable to wrap a piece of paper around them before screwing up the vise. About 1 in. of the wires should be allowed to project above the vise, when the projecting ends should be tightly twisted together by the aid of a pair of pincers.

The wires should then be removed from the vise, the twisted extremity soldered together with a little tinman's solder. To prevent after rusting it is well not to use acid or soldering fluid as a flux, but to employ rosin for this purpose. When this has been done the two free extremities of the wires are opened out to about 4 in. apart, as shown in Fig. 1, *a*, *b*. If now the two "poles" or extremities *a* and *b* of this simple thermopile, be connected to the terminals of a fairly delicate galvanometer, the pointer of which should be brought to 0° it will be found that on applying the flame of a lighted match to the junction *c*, the sufficient current will be set up to deflect the needle or pointer, through 10 or 15°. A rather more powerful

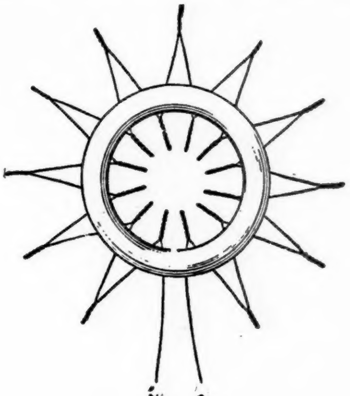


FIG. 2.

arrangement can be easily put together by making up a dozen such combinations, with the individual wires about 4 in. long only, and twisted up for a length of ¾ in. instead of 1 in. It will not be necessary to open the wires out to more than ¾ in. for this purpose. A common wooden curtain ring of about 3 in. internal and 4 in. external diameter is now chosen, and around its outer edge are drilled 24 equi-distant holes about 1-18 in. in diameter, just sufficient to allow the single wires to be pushed through. Then taking one of the pairs of wires with the copper to the left, the operator

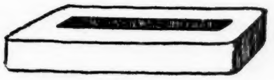


FIG. 3.

pushes the free ends thereof through the first pair of holes from the inside of the ring, until he clears the center by about ½ in. In like manner he inserts the remaining 11 pairs, taking care that each copper wire enters the left hand, and each nickel wire the right-hand hole of each pair, so that the ring, viewed from the outside, should show the free wire ends alternately copper, nickel; copper, nickel, and so on all round; and never two coppers or two nickels adjacent. Starting now on the outside of the ring, we twist and

solder together the wire proceeding from one pair joined inside to the dissimilar wire of its next neighbor; that is to say, the nickel to its neighbor's copper, and so on all round, except only the first copper and the last nickel wires, which are left free for connection to the outer circuit. See Fig. 2.

On applying heat from the flame of a spirit lamp to the junction inside the ring, a current of electricity can be taken off the two free wires Cu and Ni. Having understood the principle of the thermopile, the operator will find no difficulty in making up the more powerful instrument generally used for measuring the temperature of different radiating bodies. We will

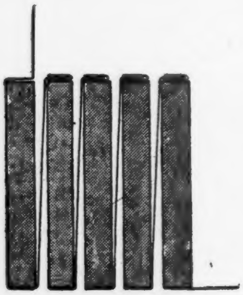


FIG. 4.

begin by making a little pattern of any hard wood 2 in. long, ½ in. square in the sides. From this, as a pattern, he will, after oiling it all over, to prevent adhesion, make half a dozen or more moulds in plaster of paris, as shown in Fig. 3. These plaster moulds must be allowed to dry thoroughly before use, otherwise in attempting to cast in them, the molten metal might sputter and fly into the operator's face. He will then cut 48 strips, 2½ in. long, ¼ in. wide, out of thin tinned iron sheet. Taking one of the moulds in hand, he will insert one of these strips at each end, projecting downwards into the cavity for about ¼ in. He will do likewise with all the other moulds he has prepared. He will then melt in an iron ladle about 2 ozs. of clean zinc, with 4 ozs. of metallic antimony, with which, when well melted and mixed, he will fill the moulds he has got ready. As soon as he sees the metal has set, he will pull out the castings by the side strips; since, as they expand considerably in cooling, they would break the moulds if allowed to get cold therein. The moulds must be again fitted with tinned iron strips, and the casting operation repeated until at least 24 little square bricks of zinc antimony have been satisfactorily prepared. These are then gone over with a file to remove any excrescences, care being taken not to break these in doing this, as the alloy is as brittle as glass The operator then joins these blocks together in five separate sets of five, one of which is shown at Fig. 4; the lower tin strip of the first block being bent upwards nearly parallel to the second block where it is turned at right angles, folded upon, and soldered to the upper strip of the second block, and so on until each set of five blocks is joined. Then each tin strip is separated from its neighboring blocks on either side, by the insertion of a thin sheet of mica 1¾ in. long by ½ in. wide. It will be noticed that there will be two free strips of tin to each set thus formed; one at the left hand top corner, and one at the right hand bottom corner. Each set of five blocks, when thus completed, could be temporarily tied together with a bit of fine twine.

The operator then cuts out six pieces of thin asbestos board, or failing that, of stout common pasteboard, 1¾ in. wide, long enough to cover the bundles of blocks from side to side, but to have the ends protruding about ½ in. at each extremity. Placing a length of 1 in. wide tape on the table, he lays one of the asbestos squares on it, puts one set of blocks squarely on it, removes the twine, then covers the first set with another square of asbestos, over which he places a second set in the reverse position, that is to say, that the free tin strips on the left hand top corner should be placed

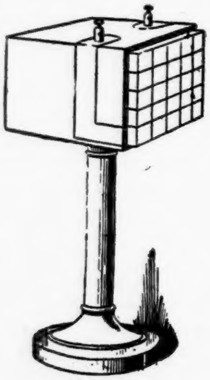


FIG. 5.

over the right hand top soldered junction of the first set. In like manner, with the same precautions of placing a layer of asbestos between each set, and of reversing the position of the free tin strip on the top corner with each succeeding set of blocks, the five sets are laid squarely one over the other, surmounted by a final square of asbestos or pasteboard. A piece of the same material is now cut to fit over the two sides; the tape bound tightly round the compound block, stitched firmly together and served out with a thin coat of shellac varnish. When this is quite dry all the projecting tin strips at the two ends, except only the first top corner left-hand strip of bottom row, and right-hand lower corner strip of top row, which must be left free for connection to terminals, are bent slightly diagonally over the side, so as to meet the free strip of the layer above alternately on the one side and on the other; to which they are neatly soldered, and any excess of tin strip cut off.

The finished thermopile should then be encased in a four-sided wooden case, about 1¼ in. wide, tightly packed in with sheet asbestos. The two free strips are then bent up to the sides of the containing case, and fitted with small terminals. The ends of the 25 blocks should project about 1-8 in. at both ends of the case, which may for convenience be itself mounted on a rather heavy column and base. In order that the temperature of the thermopile may be maintained fairly equal at both extremities when not in use, it is usual to fit the case with little covering caps at both ends, one of which can be removed when it is desired to expose one end to the effect of the source of heat to be tested. In Fig. 5 we give a sketch of the completed thermopile—"Hobbies" London.

CAISSON DISEASE.

The effects of compressed air on tunnel workers and the palliative measures to be adopted by those in charge, formed the subject of a lecture by Prof. Thos. Oliver, M. A., M. D., recently delivered before the British Royal Institute of Public Health. The author described the caisson used in such work as a strong box or casing which is allowed to sink below the surface of a body of water in order to carry on work. As the caisson has no bottom, its edges cut into the soil where it rests, sinking lower as the material excavated within is hauled to the surface and disposed of. To keep out the water, air has to be pumped in a at a pressure varying with the depth of water.

To allow the passage of material and men, what is known as an air-lock is provided at the top of the caisson, partly above water, so that access can be had to the working chamber while the pressure is maintained.

On descending into the lock, very little inconvenience is experienced by men accustomed to the work; they have a way of swallowing air and diverting some to the eustachian tube, thus avoiding injury to the ear. Once inside the caisson, very little inconvenience is felt, but loud conversation is difficult. Although it has been found advisable to limit the working period to a few hours, a man can do as much work in a given time as under ordinary conditions. It is during "decompression," on leaving the compressed atmosphere, that abnormal symptoms develop. In minor cases men suffer from pains all over the body, and bleeding from the nose, or even from the mouth and ears. In severe cases paralysis develops.

There are certain predisposing causes of this illness, among these being an insufficient supply of fresh air or the contamination of air by lamps or by gases emanating from the materials being excavated. Severe manual exertion is a predisposing cause, the men who guide buckets as they are hoisted not being subject to the disease.

When the decompressing process is carried on slowly, Nature allows the excess of gases to escape through the lungs. The red corpuscles of the blood carry carbonic acid gas, a waste product of the tissues, to the lungs. Interference with this process and the disturbance of the equilibrium between internal gases and the atmosphere are, in Prof. Oliver's opinion, the cause of caisson disease.

Since immunity from this malady among laborers will allow engineers to carry on public works requiring deeper foundations than hitherto attempted, preventive measures are of the utmost practical importance. Slow decompression, with recompression if any of the symptoms of the disease appear, is the chief preventive. Breathing an atmosphere of oxygen for five minutes before coming out of the caisson, by driving excess of nitrogen out of the blood, has been found to have a beneficial effect. In general, medical inspection and the use of every facility for the comfort and treatment of men on coming out of the caisson are advised.—"Municipal Journal."

TEMPERATURE OF THE EARTH.

The measurement of temperature at the bottom of the two deepest mines in Australia—both at Bendigo —indicates an increasing warmth, but less than that due to added depth; the difference being explained by the good effect of ventilation. The deep mines at Bendigo are close together, so as to be easily connected by levels, says "Mining and Scientific Press." The Government Inspector of Mines found the temperature at the 3856 ft. plat of the New Chum Railway mine to be 86° F., while at the bottom, at 4069 ft., the thermometer registered 88°. The water at the west end of the shaft was 94° and at the east end 96°.

In the Victoria Quartz mine, also near the New Chum reef, the temperature at the plat on the 3824 ft. level was 86°, while in the shaft at 4046 ft. it was 88°. The water was six degrees warmer. The New Chum Railway is warmer than the Victoria Quartz mine because it has an up-cast shaft, and receives air from an adjoining mine, while the Victoria Quartz receives fresh air through its down-cast shaft. As the mean annual temperature at Bendigo is 90° F, the increase at 4000 ft. is not excessive.

Two things are necessary for gasoline engine running. There must be gasoline in the cylinder and there must also be a spark. If the engine gets both spark and gasoline, it must run, providing some mechanism has not become misplaced. If an engine stops and refuses to start, first ascertain which is minus, the gasoline or the spark. Gasoline engines fail to operate properly from insufficient spark more than from any other cause.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

V. Assembling the Coil.

The secondary section windings, condenser, and other parts being completed, the important operation of assembling the coil is next in order. But little has been said regarding the core, it being assumed that the wire for the same will be purchased cut to length ready for use. This is extremely desirable, as two important requirements make the preparation of core wire by the amateur without special tools a quite difficult matter.

In the first place, core wire should be very thoroughly annealed, and this process, as carried out in kitchen stove or furnace, is not at all satisfactory, both because this kind of annealing is most imperfect, and the scale and dirt collecting on the wire prevents the subsequent gathering of the wire into a compact bundle. Wire, as annealed by wire manufacturers, is kept in the furnace for several days, and is entirely free from scale. The cutting is done by machine, and each piece is straight, and all are of the same length, making the work of forming the core much easier and better than it otherwise would be. A core made of such wire will also more strongly energize the coil than will one made of poorer and rougher wire. The importance of using the best possible core wire cannot be too strongly emphasized, especially with coils of large size, where the value of a heavy outlay for magnet wire may be to quite an extent lost because of a poor core.

The operation of forming the core should be very carefully done. The writer has found the following method gives good results, and is as convenient as any which he has seen described. A cylindrical bundle of loose wire slightly larger than the ultimate size of the coil, is gathered in one hand, and several small rubber bands slipped over it. The bundle is then rolled on a smooth, flat surface, to bring the wires as closely together as possible, adding additional rubber bands as the rolling proceeds. When the bundle is made as compact as possible, the size should be that desired for the core. If too large remove a few wires, one at a time, and continue the rolling until the correct size is reached. It is easier to reduce than to increase the size, so the bundle at first should be fully large enough.

The next process is to wind the bundle with strong, black linen thread, in close even layers, beginning at one end and winding to the other, removing the rubber bands as the winding proceeds, and using the greatest care that the bundle is not forced out of round by the winding. Only one layer of thread is necessary, allowance being made for same, as well as the primary winding in determining the size of the core. The layer of thread being in place, the core should form a round, solid bundle, which will be free from movement when the finger is applied to any part. A coating of shellac, or mixture of paraffine and beeswax, should then be given the core, the latter being preferable except in hot climates. Two or three layers of strong manila paper are then wound upon the core, the number being dependent upon the thickness of the paper and the purpose to give a smooth surface upon which to wind the primary. The primary is then wound in even layers upon the paper surface just mentioned. Finally, the core is given a complete boiling in the paraffine-beeswax mixture until all bubbles cease to rise therefrom. The mixture must be heated in a water bath, and owing to the shape of the core, utensils for this purpose will not be easily obtained by many. If a tin can, used for shipping photographic carbon paper, can be obtained from a photographic studio, it will be found just the thing, after cutting off to the desired length. Any deep kitchen utensil can be used to contain the water and tin holding the mixture.

After a thorough boiling in the mixture, the core is removed, but will have to be basted on the outside ends with the mixture, as the iron retains the heat longer than the mixture, keeping the mixture fluid in the center for some time after that on the surface has hardened. As it cools it contracts, and the basting is necessary to avoid cracks. Just before the mixture becomes cold and set, the core is placed inside of the ebonite or mica tube, which separates it from the secondary, and any space between the primary and ebonite tube, filled with the fluid mixture. The ebonite tube should be a fairly close fit over the primary, when the latter has been coated liberally with the mixture; too much space reducing the output of the coil.

The bobbin, or coil end, is then placed in position at one end, and the secondary sections put on, taking the greatest care to see that joints between double sections are well made by soldering and then fully insulated with thread. The paraffine mixture is kept at hand, and the space between the inside of the sections and the ebonite tube completely filled with the mixture, which is applied to the joint between sections. Care must also be taken to see that the sections are put on with the windings in the right direction, so that the current through them will be in a uniform direction around the core. Extra care must be taken at the ends of the secondary to see that the insulation is ample, as the tendency to break down and short circuit is greatest at the ends.

The leads from the secondary to the terminal posts should be taken from the tops of the windings, so that they will be as short and direct as possible. It may be necessary to unwind the ends of the two end sections to do this, but this is easily done. In connecting up the sections it is also advisable to test frequently for breaks, and if any are suspected because of poor sparks, careful inspection should be made and the trouble located before proceeding with the work. By testing for breaks is meant the use of a battery of four or five dry cells and a galvanometer, leads with detachable clips being used for connections.

HINTS FOR YACHTSMEN.

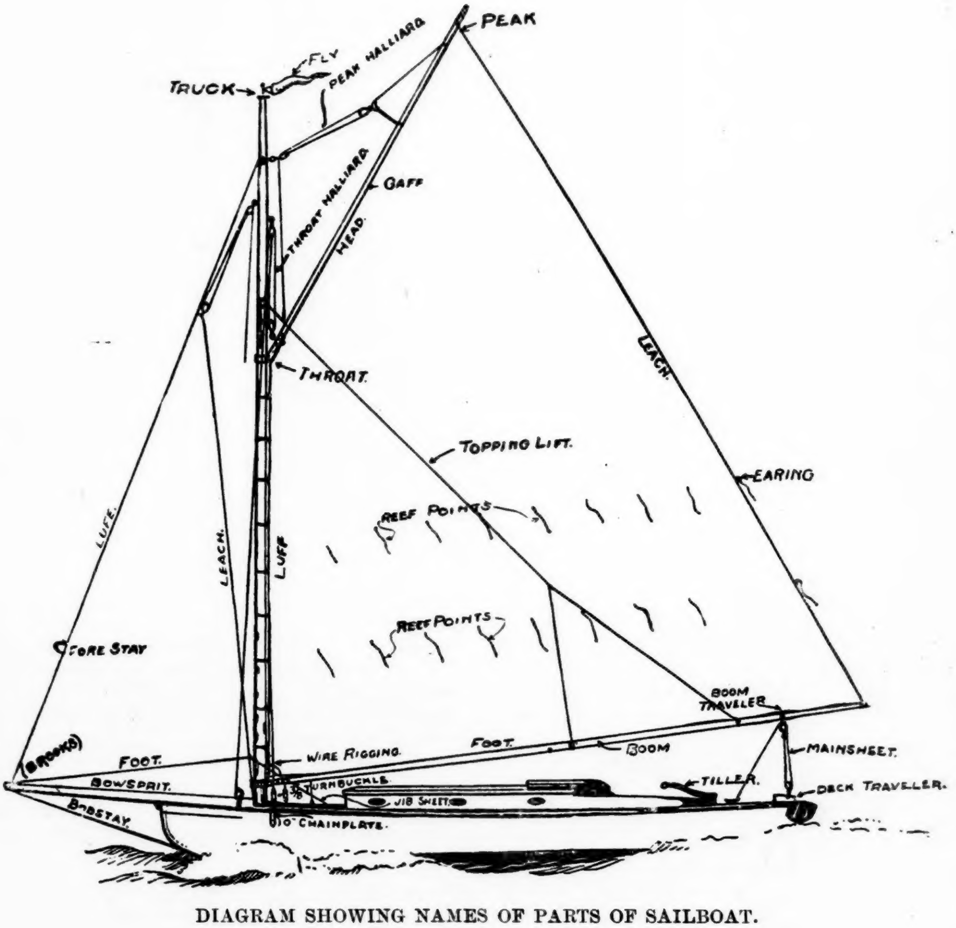


DIAGRAM SHOWING NAMES OF PARTS OF SAILBOAT.

NAUTICAL TERMS.

Starboard—Right hand side of boat.
Port.—Left hand side of boat.
Aft.—Toward the rear.
Forward.—Middle section of boat.
Fore and Aft—From bow to stern.
Athwartships—From side to side.
Aloft—Above the deck.
Below—Beneath the deck.
Abaft—Towards the stern.
Avast—To cease, stop.

A SHORT SPLICE.

The accompanying illustrations show the different stages of a short splice, such as is used for making an eye in the end of a rope. The strands are first unlaid

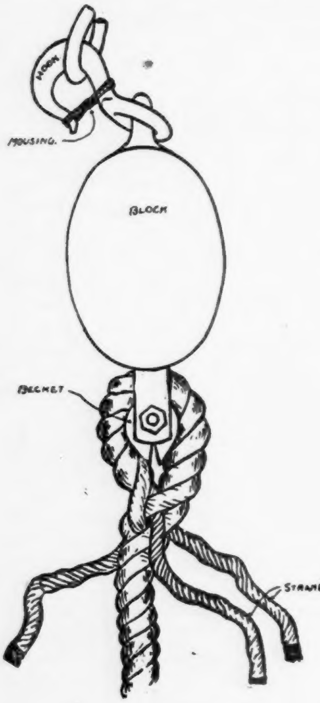


FIG. 1.

FIG 2.

or separated. For convenience of handling, the ends of the strands are sometimes whipped, as shown in Fig. 1. The strands are then tucked under the standing part of the unlaid rope, as shown in Fig. 1. This operation is repeated by tucking again and then each strand is divided, as shown in Fig. 2. The splice is then finished by tucking one-half of each strand, as shown in Fig. 3. This last tuck will taper off the splice. To loosen or raise the strands of the rope, so that you may tuck under them, a pointed marlin spike is used.

FIG. 3.

In splicing two ends of rope together the operation is the same, only in this case you will have two ends or six strands instead of three, and will of course tuck both ways from the center.

BELL TIME ON SHIP BOARD.

No. Bells.	Time.	Time.	Time.
1	12 30	4 30	8 30
2	1 00	5 00	9 00
3	1 30	5 30	9 30
4	2 00	6 00	10 00
5	2 30	6 30	10 30
6	3 00	7 00	11 00
7	3 30	7 30	11 30
8	4 00	8 00	Noon.

SIGNALS TO ENGINEER.

When engine is stopped, one bell means go ahead slow.

When engine is running either way, one bell means stop.

When engine is going full speed either way, three bells mean check down.

When engine is stopped, two bells mean go astern.

When engine is going ahead, two bells mean reverse and go full speed astern.

LIGHTS.

Lights must be carried on all boats from sunset to sunrise.

White light is placed forward and is screened so as to be visible over ten points of the compass on each side.

Red light is placed on the left or port side and is screened so as to be visible from straight ahead to two points abaft the beam.

Green light is placed on right or starboard side and is screened so as to be visible from straight ahead to two points abaft the beam.

Upon being overtaken by another vessel, a white light must be shown astern.

A sail vessel carries two side lights only, but when approached by another vessel shows a bright light or torch from the point in which the other vessel is approaching.

Rules regarding lights apply to boats under way only.

When laying at anchor a white light visible all around the horizon is shown.

A row boat should carry a white light and show it upon the approach of another boat.

BUOYS.

In accordance with Section 4678 of the Revised Statutes of the United States, the following order is carried out in the coloring and numbering the buoys along the coast, or in the bays, harbors, sounds or channels, viz.:

1. In approaching the channel, etc., from seaward, red buoys with even numbers will be found on the starboard or right side of the channel.
2. In approaching the channel from seaward, black buoys with odd numbers will be found on the port or left side of the channel.
3. Buoys painted with red and black horizontal stripes will be found on obstructions, with channel ways on either side of them.
4. Buoys painted white and black perpendicular stripes will be found in mid-channel, and be passed close to.

When perches with balls, cages, etc., are placed on buoys, it indicates that they are turning points, the color and number indicating on which side they shall be passed.

To use a buoy for mooring purposes with a boat is unlawful and punishable by fine and imprisonment, except when such mooring is done for the purpose of saving life.

The U. S. Government Sailing Rules, as applied to your district, together with a classified list of all lights, beacons and buoys, giving their description, character and location, will be sent you upon request to the Secretary of the Treasury, Washington, D. C.

STEERING AND SAILING RULES.

SAILING VESSELS.

When two sailing vessels are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

(*a*) A vessel which is running free shall keep out of the way of a vessel which is closehauled.

(*b*) A vessel which is closehauled on the port tack shall keep out of the way of a vessel which is closehauled on the starboard tack.

(*c*) When both are running free, with wind on different sides, the vessel which has wind on the port side shall keep out of the way of the other.

(*d*) When they are running free, with the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.

STEAM VESSELS.

When two steam vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each shall pass on the port side of the other.

When two steam vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

When a steam vessel and a sailing vessel are proceeding in such directions as involve risk of collision, the steam vessel shall keep out of the way of the sailing vessel.

Where, by any of the rules here prescribed, one of two vessels shall keep out of the way, the other shall keep her course and speed.

Every steam vessel which is directed by these rules to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop, or reverse.

Notwithstanding anything contained in these rules, every vessel overtaking any other shall keep out of the way of the overtaken vessel.

In all weathers every steam vessel under way in taking any course authorized or required by these rules, shall indicate that course by the following signals on her whistle, to be accompanied, whenever required, by these rules, shall indicate course by the following signals on her whistle, to be accompanied, whenever required, by corresponding alteration on her helm; and every steam vessel receiving a signal from another shall promptly respond with the same signal: One blast to mean, "I am directing my course to starboard." Two blasts to mean, "I am directing my course to port." But the giving or answering signals by a vessel required to keep her course, shall not vary the duties and obligations of the respective vessels.

SAILOR'S RULE OF THE ROAD.

When both side lights you see ahead
Port your helm, and show your red.
Green to green, or red to red—
Perfect safety—Go ahead!
If to your starboard red appear,
It is your duty to keep clear.
To act as judgment says is proper;
To port—or starboard—back—or stop her.
But if upon your port is seen
A steamer's starboard light of green,
There's not so much for you to do,
For green to port keeps clear of you.

SITTING ROOM FURNITURE.

[Continued from Page 265.]

provided with the side stretchers glued to legs and treated with hot glue in mortise holes of the back posts. Drive these in them, gluing the seat mortises; drive into place the legs.

In this class of work—open and liable to spring out of true—it is well to have a rule, or trying stick, to immediately square the frame before the glue has positively set, the bar clamps sometimes being brought into good use, to pull into place a refractory part. When the chair is well set, cut the back posts at bottom ⅝ in. to give proper inclination. Clean off any excess of glue and hand sand from top to bottom, taking off any crude edges.

An arm chair to match this pattern may be constructed from a drawing making the size of seat proportionately 2½ in. larger than called for in Fig. 5, and the height 32 in., between arms 19½ in. and the height of arms 10 in. from the seat.—"Carpentry and Building."

THE ONDOSCOPE.

An excellent simple device, known as the "Ondo scope," has been devised by Prof. Ruhmer, of Berlin for examining alternating or pulsating electric dis charges. The following description is taken from the "Electrical Review", London:

The principle of the apparatus is based upon the the discovery by H. A. Wilson, in 1902, of the fact that the violet glow round the cathode of a Geissler tube varies in dimensions in proportion to the current strength, while it is, of course, free from inertia and, therefore, follows changes in the current with absolute precision and instantaneity. The instrument devised by Ruhmer to take advantage of this phenomenon consists of nothing more than two wires sealed into an exhausted tube about a foot in length and one inch in diameter, with their inner ends close to a small hole in a mica screen.

Viewed directly, when it is connected with the terminals of an induction coil, a steady violet glow surrounds the end of each wire; but when viewed in a revolving mirror, it is seen that the glow occurs alternately on the one and the other of the wires, never on both at once. Moreover, the luminous images, drawn out by the inventor of the mirror, show by their outline the changes in the current strength with regard to time and in its direction. The effect of varying the frequency and duration of make and break, the potential difference applied to the primary coil and the nature of the secondary circuit can thus be studied with the greatest ease and convenience.

On inserting a Villard valve-tube in the high-pressure circuit, the current becomes unidirectional, though of course still intermittent. Using the ondoscope in a series with an X-ray tube, with a valve-tube in circuit, the strength of current can be estimated, or even roughly read off on a scale, with the instrument; the latter also serves to verify the fact that all the discharges occur in one direction only, testifying to the efficacy of the valve-tube which exercises an extraordinary powerful action as a rectifier. A singular fact which is shown by the ondoscope is that the discharge through an X-ray tube is practically instantaneous, the luminous image consisting simply of a narrow streak, no matter how rapidly the mirror was turned. By photographing the images a permanent record can, of course, be obtained.

The ondoscope with about 300 volts potential difference, so that it is available for use on ordinary high-pressure alternating circuits; while it is lacking in some of the advantages of the oscillograph, it unquestionably yields a considerable amount of information regarding wave-form, oscillations, etc., with the minimum of trouble and expense, and it can hardly get out of order.

NEW ELECTRIC LAMP.

Consul E. T. Liefield forwards from Freiburg an abstract from a Paris newspaper concerning a new electric lamp which, it is said, will revolutionize the present system of lighting. The article was wired from Vienna, and reads:

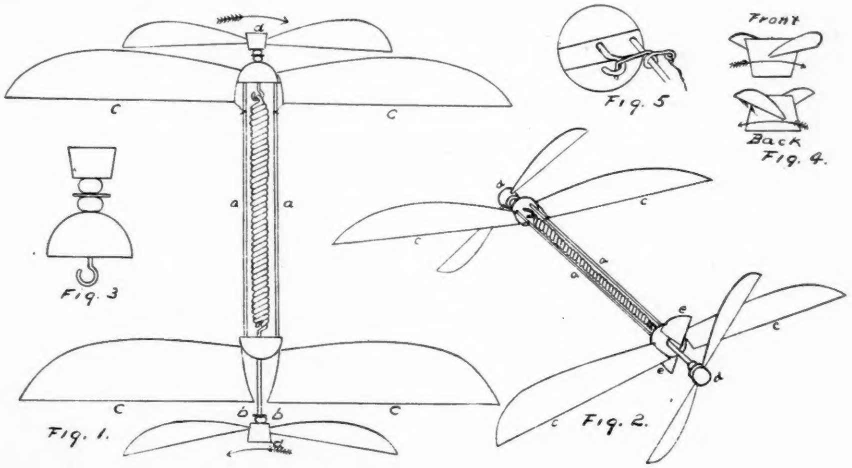
An Austrian chemist, Dr. Hans Kuzel, has, after many years' hard work, succeeded in constructing a new electric lamp, which he calls the Syrius lamp. As is well known, incandescent gaslight is cheaper than electric light, because the filament wires of the latter are very expensive and the glass bulbs soon wear out. Dr. Kuzel has now invented a new substitute for the glow-thread, by forming out of common and cheap metals and metalloids colloids in a plastic mass, which can be handled like clay and which, when dry, becomes hard as stone. Out of this mass very thin wire threads are then shaped, which are of uniform thickness and of great homogeneity. These two characteristics are of great value in the technics of incandescent lamps.

The Kuzel or Syrius lamp hardly needs one-quarter of the electric current which the ordinary electric lamp with a filament wire requires. Experiments, it it is asserted, have shown that the lamp can burn for thirty-five hundred hours at a stretch. Another advantage is that the intensity of the light of the new lamp always remains the same, the lamp bulbs never becoming blackened, as is now the case. The new lamp, it is said, will be put on the market next autumn.

A SMALL FLYING DEVICE.

J. CARSON PRESS.

The illustration shown here is that of a small flying machine, and presents a form of amusement that has seldom, if ever, been made the subject of experiment for boys. It is exceedingly simple, practical and inexpensive, and opens up a vista of enjoyment through the summer months that cannot fail of recognition, especially as there are several other types, not quite so simple, 'tis true, but equally well within the means of every owner of a penknife, and some constructive ability. Fig. 1 shows clearly the general outline and disposition of the wings, propellers, etc., and requires only a few general directions as to the measurements, and materials to make it plain to the reader.



Before starting to work procure, if possible, one of those 3ft. bamboo pipe stems the tobacconists sell; cut from this the strips used in the frame, wing arm, etc. This wood is light and pliable and is the best for the purpose. If it cannot be had, use a light wood that will bend. The frame at *a a* is made by inserting the ends of two sticks each 9 in. long, ⅛ in. thick, into two half cubes of cork, fastening with glue. To make the half cubes, cut half a cork to get pieces about 1 in. in diameter and ½ in. thick. See Fig. 9. A short round stick *b*, 3 in. long, is fitted to a depth of ¼ in. in one of the pieces of cork. The stick must have a hole through it, so it is best to use the stem of a corncob pipe.

The wing arms *c c c c* are 9 in. long, ⅛ in. thick, tapering at the outer ends. Insert the thick ends in the cork, giving them a slight upward pitch, making a very obtuse V. Then, after the glue has set, tie a light cord to the tips and bend until they measure 3 in. from tip to frame; fasten cord to frame. The wings should not be in exact line with the frame, but should point slightly downward; the proper angle is obtained by tying the cord to the under side of the frame sticks.

The propellers *d d* are two-bladed. The blades are made similar to the wings. Cut four sticks 7 in. long and very thin; bend until they measure 6 in. from tip to root. Fasten with thread, allowing for ¼ in. or so of the end to be pushed into the cork. Next take two corks the size of a dime and ¼ in. thick; fit the blades in these at an angle of about 40°. Remember in this connection that, as the propellers revolve in opposite directions, the blades must also be reversed. See Fig. 4.

Then take two pieces of brass spring wire, one 2 in. long, the second 3½ in. long, and fashion a hook on one end of each. To these hooks are fastened the propellers and rubber. Pass the long hook through the cork and length of pipe stem, the short through the other end. Place on each two small beads with a tiny washer between, push the free ends through the center of the propeller corks, taking care to see that the propellers, revolving in opposite directions, shall serve to lift the machine upward. Fasten the wire as shown at *a* in Fig. 3.

The small vertical rudder seen at *b* is made from spring wire 7 in. long, bent to a half circle by a cord running from two small hooks formed on each end.

The wings, propellers and rudder are covered with silk, or a good grade of linen paper might be best, as a smooth surface is an advantage. If silk is used, keep it spread out by pinning it to a board, then coat the sticks with glue and lay them on the silk, cut out afterwards; this will prevent wrinkles. The motive power is twisted rubber; you will require five small bands, each 3¼ in. long, and ⅛ in. wide. Knot them together double and pass the free ends over one of the hooks, and where it is doubled over the other hook, making two lengths. If, after trial, this seems insufficient, or the machine does not fly very fast, add another length of thinner bands and twist the rubber by giving the propeller about 75 turns.

You will need something to hold the propellers from turning until ready to fly the machine. Make two small catches of the shape seen in Fig. 5; fasten these to the frame so that one end engages in the hook with the rubber. To the other end is fastened a light cord, which runs back to the end of the second catch. By pulling this cord, both propellers are released at the same time. The machine should fly in a horizontal or slightly rising line; if it has a tendency to dip downward, reduce the angle of the back wings by twisting the cords around from the underside of the pipe stem to the side, and finally to the top if necessary.

The best way to commence is to first jot down the measurements of the different parts on a separate sheet of paper; first the frame rod *s*, then the wing arms, and so on. Then, with the directions in this concrete form, proceed to get out the different parts; the frame first, in the order of their presentation here. The corks used should be firm and sound, and all parts should be well glued together. Use a little judgement and your best workmanship, and the result will be highly gratifying.

GASOLINE ENGINES.

Continued from Page 258.

The base is in two parts, split on the line of the shaft and bearings. The valve chest is on the back of the cylinder; *I* is the inlet opening and *E* is the exhaust; *V* is the valve stem. The gears are inside the case, as in Fig. 15; *T* is the ignition device. This particular type requires very little outside lubrication as the base, being tight, may be partially filled with oil, which by the action of the crank, is splashed over the working parts, keeping them well oiled.

At *P* is the electric igniting device, and at *c* is the compression cock. The elbow *A*, leading to the inlet valve, is held in place by a clamp, and when removed exposes the two valves.

In a single cylinder engine, the valve chest may be in the most convenient position. Referring again to Fig. 13, the inlet and exhaust chambers may, instead of being on opposite sides of the cylinder, be placed alongside of each other on the same side, and may then be actuated by the same cam shaft, saving some complication and making the engine rather more compact. In multiple cylinder engines this is a very common arrangement although seldom used in single cylinder engines.

The mechanical operation of the valves and the fact that the impulses take place only on alternate revolutions, make the proper sequence of events possible for revolution in one direction only, with the usual types of mechanism. For this reason the four-cycle engine can be adjusted to run in one direction only unless by means of special valve gear. There are four-cycle engines built which may be run in either direction, but they are not common.

For starting the four-cycle engines, a handle in the flywheel rim may be used, as in the two-cycle, but the more common device is a removable crank fitting over the end of the shaft jnst in front of the flywheel and provided with some kind of rachet attachment to allow the engine to continue its rotation, leaving the handle stationary. This is possible, since the four-cycle engine runs in one direction only.

ELECTRICITY IN THE HOME.

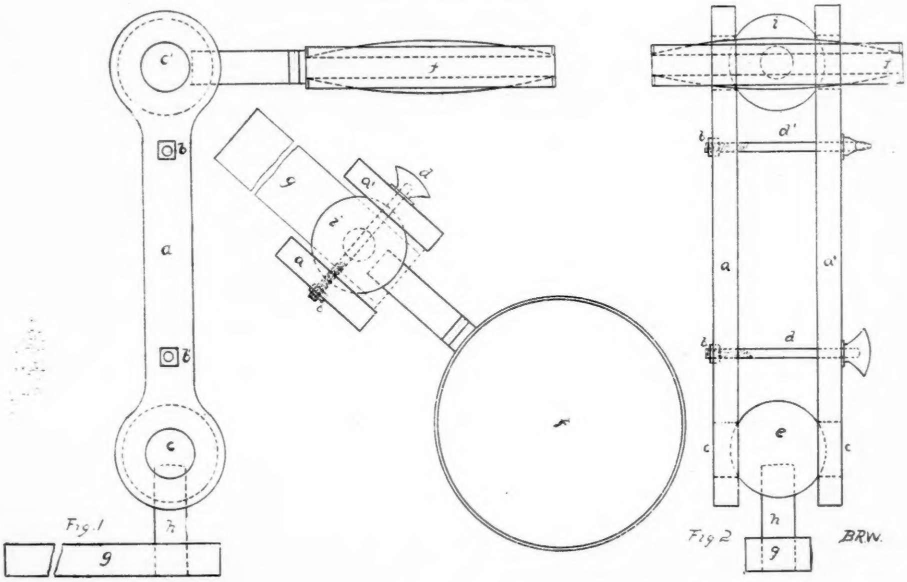
An interesting argument for the use of electricity in domestic heating is presented by Mrs. Ellen H. Richards, instructor in sanitary chemistry at the Massachusetts Institute of Technology, Boston, in her recently published book, "The Cost of Shelter." The point is brought out that this age of machinery has set free the human laborer, if only he will qualify himself to use the power at hand. The house will become the first lesson in the use of mechanical appliances in control of the harnessed forces of nature, and of that spirit of co operation which alone can bring the benefits of modern science to the doors of all. To manage the machine driven house will require delicate handling, but let women once overcome their fear of machinery and they will use it with skill.

The undue influence of sentiment retards all domestic progress. "Heating might now be accomplished," says Mrs. Richards, "without dust and ashes, without the destructive effects of steam, if enough houses would take electricity to enable a company to supply it in the form of a sort of dado of carrying wires safely imbedded in a non-conducting substance, or in the form of a carpet threaded with the conducting wire. Both heating and cooling apparatus could be installed in the shape of a motor to replace the punkah man and the present buzz-wheel fan, and to give fresh air without opening windows, which leads to half our housekeeping miseries.—" Electrical World."

The safety of illuminating oil is determined, not by its burning point, but by its flashing point.

MAGNIFYING GLASS HOLDER.

B. R. WINSLOW.



For very fine work in the drafting room and the shop, it is advisable to use a magnifying glass. It saves the strain on the eyes, prevents ruffled tempers and makes neater work possible. To work through a glass, however, some means must be provided for holding the glass in position and allowing a free use of both hands. Such a support must be so constructed that the glass may be placed at any angle and in any position. The drawing illustrates a satisfactory support, the construction of which is quite simple, and the cost of material a mere trifle.

The following material will be required: 2¾ feet of well seasoned oak strip, 1½ in. wide and 5-16 in. thick; two wooden balls about 1½ in. in diameter; two thumb bolts 1¾ in. long, and a reading glass at least 3 in. in diameter. The balls can be purchased at a toy store for a penny each. They are usually painted, but this can be easily scraped off.

From the oak strip cut two pieces 3 in. long, and with a bracket saw or knife, shape them as shown at *a*, Fig 1. The circles which form the ends are 1½ in. in diameter, and the connecting strip is ⅝ in. wide. In the center of each of the end circles bore a hole 9-16 in. in diameter, *c*, Fig. 1. Next bore two holes in each centerpiece, *b b*, Fig. 1, ¼ in. in diameter, about 2½ in. apart, and equal distances from the ends.

In one of the wooden balls, *e*, Fig. 2, bore a ⅜ in. hole about half way through the ball. In the other ball, *i*, Fig. 2, bore a hole large enough to take the handle of the reading glass, *f*, making a tight fit. From the oak strip cut a peg, *h*, Fig. 1, ⅜ in. in diameter, and about 1½ in. long, and fit one end tightly in the hole in the ball *e*, Fig. 2. Take a piece of the oak strip one foot long and bore a ⅜ in. hole in one end, *g*, Fig. 1. and in this hole fit the other end of the peg *h*, making it tight. Glue may be used in both cases.

Countersink the nuts of the thumb bolts in the holes *bb*, in one piece, *a*, Fig. 2. Insert the thum bolts *d* and *d* in the other piece, *e*, Fig. 3, and screw them part of the way into the countersunk nuts. Fit one end over the ball *e*, Fig. 2, and screw the lower bolt tight. Fit the other ball, *i*, in the other end and tighten the upper bolt. The assembling of the parts is shown clearly in the drawing. Fit the handle of the glass in the hole in the ball *i*, and it is ready for use.

If the thumb nuts shown in the drawing are not readily obtainable, ¼-in. machine bolts, 1¾ in. long may be used by countersinking the bolt heads in one piece and screwing a thumb nut on the other end in place of the regular nuts.

When in use the base *g* rests on the drawing board or bench, being held securely by the clamp. If clamps cannot be used, the support may be firmly attached by means of a long screw eye in the extreme end. A little manipulation of the support will soon demonstrate that the glasses can be held at any angle and in any position. To change the position of the glass it is only necessary to loosen the bolts a trifle.

BOAT SAILING FOR AMATEURS.

C. C. BROOKS.

The wind has four direct effects on a sail boat which must be understood by the amateur sailor before he can begin to see why his boat performs differently under different conditions of wind and sailing course.

The wind drives the boat ahead—most important of all; it also drives it laterally or, to speak in a nautical term, causes it to "make leeway"; it heels the boat over and lastly turns it around, according to the balance of her sails, distribution of weight, and what is known as the "center of lateral resistance." The proper handling of sails and rudder is what enables the sailor to so utilize these effects of the wind that he may sail his boat in any direction.

The propelling effect is the one most utilized, and it is for this reason that every boat is constructed to offer the least resistance to its forward movement with as little friction as possible.

Leeway is one effect to be avoided, and for this purpose boats are given either deep, stationary keels or center boards, or some other device for providing an extensive lateral surface below the water.

Heeling and the stability of a boat go hand in hand. The boat must be prevented from capsizing, and this is done either by putting lead or iron on the keel, or carrying ballast in the hull in order to lower the center of gravity, or by building a broad and shallow boat such as the cat boat, which is very stiff in a breeze and does not heel readily, but when a certain point has been reached, is apt to capsize quickly in the hands of an unskilful sailor.

The fourth effect is that of turning the boat around. This is done when the center of effort on the sails does not come on a line with the center of lateral resistance. This is always the case in a poorly balanced boat. A well balanced boat requires very little movement of the rudder to hold to a course.

Any novice can understand how a sailing boat can travel with the wind, but why it should go forward when the sails are close hauled is a question of dynamics which we will not try to explin in this short article. An easily understood explanation of why boats go ahead instead of sideways can be made by taking a V-shaped block of wood and pressing it between the thumb and forefinger. If sufficient force is used it shoots forward quickly. The thumb may be likened to the wind and the forefinger to the water on the opposite side of the boat. The pressure caused by the wind pushing the boat against the water on the opposite side causes the boat to go forward.

The center of effort and center of lateral resistance must be understood in the handling of a sail boat. The center of effort is the center of the total sail area. If, for example, this comes forward of the center of lateral resistance when the boat is sailing with the wind abeam, then the side pressure on the sails will turn the boat's bow in the direction towards which the wind is blowing, or away from the wind, and a boat doing this is said to carry a "lee helm."

On the other hand, if the center of lateral resistance is further forward than the center of effort, the wind will swing the boat in the direction in which it is blowing, thus throwing the bow up into the wind. A boat doing this is said to carry a weather helm. Every sailing boat should be so rigged as to carry a little weather helm as, if struck by squall under those conditions, it will luff quickly up into the wind and so be in safety, while if the lee helm is carried, the boat will fall off before the wind, presenting a broadside to wind and wave which is very apt to cause it to capsize.

Too much weather helm is also to be avoided as it makes it necessary to keep the rudder over at a sharp angle and retards the progress of the boat.

To reduce weather helm, move the ballast aft or shorten the after canvas or increase the forward canvas by setting a larger jib. If a boat carries a lee helm, shift the ballast forward or reduce the area of the head canvas.

In considering the action of the rudder, the amateur sailor should bear in mind that as the boat is turned by the rudder it swings as on a pivot. The water, pressing against one side of the rudder, pushes the stern of the boat away from that side.

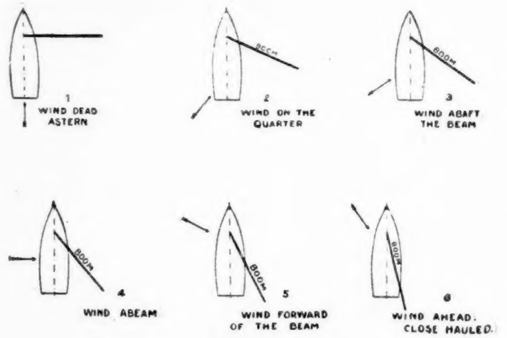
The pivot or turning point is always well forward of the center. This is a fact that should be remembered when steering close to a boat or other object. Don't delay turning out of the way too long or the very act of turning your boat will throw the stern over sufficiently to cause the collision you are trying to avoid.

SAILING.

Running before the wind may look like the ideal course to the amateur sailor, but a little experience cures him of that belief. Fig. 1 shows the location of the sail when on this course. Steering is difficult when running with the wind aft, especially in rough water, and there is danger of the sail gybing over when least expected. Except on smooth water it is better to haul the boat up so as to have the wind on one quarter, and after following that course for some distance, to "take the other tack," gybe over so as to bring the wind on the other quarter. Fig. 2 represents the wind on the quarter. Fig. 3 shows the wind abaft the beam. Fig. 4 shows the wind abeam, or directly at right angles with the boat. Fig. 5 shows the wind forward of the beam. Each figure shows the

proper location or direction of the boom or, in a nautical term, how the sail should be trimmed. All of these are what are known as favorable winds, the sheet being hauled in such proportion as to give the best results. The positions in all of these figures show a boat when it is what is termed "sailing free."

To sail "close hauled" means to bring the boat up as close into the wind as possible and still keep it on its course, with the wind filling the sail so as to drive it forward. A properly built boat will lie within four or four and a half points of the wind, while some, especially those built on racing models, will do even better than this. Fig. 6 shows about the proper lo-



SAILING.

cation of the boom when sailing close hauled. The wind, striking the sail at this angle will drive the boat forward and maintain a reasonable degree of speed, while to haul it closer would increase the leeway until, if the sail were hauled parallel with the keel, the only progress made would be to leeward. Most boats will sail closer to the wind in smooth water than in a rough sea.

When sailing close hauled, it is necessary to hold the boat on a course that will just nicely keep the sail filled with wind. This point can be ascertained by putting the helm slowly to the leeward. As soon as the sail begins to shake near the head, you have reached a point where it is not drawing as much as it should and, if the helm is kept down, the sail will begin to flap in the wind and the boat will lose headway. A little practice will enable an amateur skipper to see the beginning of this "tremble" in the sail, and at the first symptoms he must reverse the helm until the wind fills the sails fairly.

HINTS TO BE HEEDED IN SAILING SMALL BOATS.

To bring the boat up into the wind and reef a sail, lower the sail partially. First lash the cringle on the luff or forward edge of the sail, then stretch the foot of the sail taut with the after cringle and secure it. Roll the sail neatly and tie all the reef points with a square knot and haul the sail taut again. If reefing has been delayed too long, it may be necessary to lower the sail entirely before reefing. If sailing in a river or near shore, the safer plan when reefing is to run the bow of the boat on the bank before attempting to reef. Always stand to the windward of a sail when reefing.

To be always on the safe side, never belay the sheet. If desired, one turn may be taken about a cleat, holding the end so as to ease off quickly when necessary.

A good sailor will bring the boat up into the wind rather than ease off the sheet when struck by a puff of wind, but in sudden squalls both manœuvres may be necessary.

Remember that your boat is not liable to capsize if the sheet is free so as to permit the sail to move in a direction parallel to the wind.

In small boats the safest plan is to take the boat promptly towards the nearest land in case of sudden storms approaching. Don't wait for them to strike before seeking safety and, when preparing for a storm, all persons in the boat except the helmsman, should sit amidshsips on the bottom of the boat and stay there. Always have an eye on the wind, watching for the approach of sudden puffs which might cause trouble.

Do not attempt to tack when a big wave is coming on the weather bow, and do not forget to shift your seat to the windard of the tiller at every tack.

If sailing close to the wind in a sea and an ugly, breaking sea is coming, safety lies only in putting the helm down and luffing right into the wave so as to take it end on, or nearly so, and as the wave passes, put the helm up and fill the sails so as to avoid losing headway.

Table of specific gravities:

Aluminum	2.68	Lead, cast	11.35
Antimony, cast	6.71	Phosphorus	1.82
Bismuth, cast	9.82	Platinum, rolled	22.07
Brass	8.38	Pyrites, iron	5
Coal, compact	1.32	Quartz	2.65
Copper, drawn,	8.88	Silver, cast	10.47
Copper, cast	8.79	Sodium	0.97
Diamond	3.52	Sulphur, native	2.03
Gold, stamped	19.36	Tin, cast	7.29
Gold, cast	19.26	Zinc	6.86
Graphite	2.30	Sulphuric acid	1.85
Iron, wrought	7.79	Mercury	1.52
Iron, cast	7.21	Nitric acid	1.42

Before water can become steam the upward pressure of its vapor must overcome the downward pressure of the atmosphere; hence it follows that the boiling point of water is conditioned by the atmospheric pressure. Water boils at a much lower temperature on mountain tops, where the pressure is comparatively small, than in the valleys.

CORRESPONDENCE.

No. 154. PARIS, TEX., JUNE 7, 1906.

Will you please answer the following questions:

1. Does heat destroy the resistance of German silver wire?

2. In using wire like samples enclosed (Nos. 23 and 30 gauge) for a ½ in. spark coil, what would be the specifications for winding, using the larger wire for the primary?

3. Please give directions for making a transmitter to work on a line 300 ft. long.

4. Could German silver filings be used in a coherer together with nickel filings. P. C.

Heat increases the resistance of all metals excepting carbon, but the rate of increase varies with different metals. It is very small for German silver, which is only one ninth that of copper.

2. The samples of wire you enclose are not suitable for making up spark coils. The larger gauge is too small for the primary, and the finer one too large for the secondary. As the cost of suitable wire for a coil to give a ½-in. spark is small, it would be advisable to purchase new wire.

3. An answer to this question requires too much space for this department. A special article will be published as soon as it can be prepared.

4. A coherer should be made as efficient as possible, as they are not any too sensitive at best. We have yet to learn of German silver filings having any advantages over the usual iron and nickel combination.

No. 155. SUMMIT, N. Y., JUNE 18, '06.

Will you kindly answer the following questions:

I desire to connect my workshop in the barn with the house by telephone, but do not care to spend a large sum to do so. Will you tell me the cheapest and simplest method for doing it? The distance is about 300 feet, and I have two single pole receivers. Can they be wired up to serve the purpose? Would it pay to use magneto generators for calling instead of batteries? Please send me a diagram of the connections of small, two station telephones. Is it possible to connect another instrument to these telephones by using extra wires, or other mechanism, etc. If so, please send diagram. A. J. M.

Two ordinary telephone receivers can be used for a telephone line by having a complete metallic circuit of insulated wire, except in the open air, where bare wire may be used. The connections should be made so that the coil windings of each transmitter will send the current in the same direction around the line; or, in other words, one coil should not oppose the other. The distance you mention is rather too long for satisfactory results by this method, and a microphone transmitter will probably be necessary. An article describing a simple and inexpensive telephone, suitable for distances up to 200 yards, will be published in an early issue. Magneto generators are necessary for calling only when the distance is greater than that for which a battery current is adapted, about 500 yards. The desired diagrams are enclosed with answer. Several battery telephones can be connected together by using an extra wire for each added station over two, and two extra wires for the ringing circuit.

No. 156. SOMERVILLE, MASS., JULY 4, 1906.

What size spark could I expect to get with a 10-volt current from a coil made as follows:—Coil is 10 in. long and 6½ in. diameter, with secondary made in eight sections, of No. 28 gauge wire. There are three layers of paper between each layer of wire. Shellac is used as an insulator. What size spark would I get on a circuit, cut down by a resistance of sulphuric acid batteries. J. P. C.

The information given is not adequate to even hazard a guess as to the length of spark possible from the coil, but the size of wire used in the secondary and the excess of paper between layers would indicate a very small spark. Complete specifications as to core, primary, secondary and insulation are necessary to calculate the capacity of a coil, and even then the workmanship is a large factor in determining the output. If the primary will carry a 112-volt current, presumedly from a lighting main, the spark might be increased slightly, but the information given indicates that the proportions of the coil are faulty.

No. 157 MINNEAPOLIS MINN., JUNE 10, 1906.

Will you please tell me whether or not an alternator will take the place of a current breaker and condenser. J. A. Fleming, in "Magnets and Electric Currents" says: "The condenser is, therefore, an essential adjunct in a coil intended to give long sparks from the secondary circuit, but is of no value if the induction coil is used with alternating currents." Can you tell me whether it is advisable to use an alternator? In the above I refer to the use of a 12-in. coil for use in wireless telegraphy. W. C. R.

An alternating current dynamo may be used to furnish current for operating induction coils in place of a direct current. In such a case, the vibrator, if there is one, is screwed up tight against the core and the condenser cut out of circuit. Currents from alternating lighting circuits are frequently used for coils, but special interrupting apparatus is generally needed to enable such currents to be used satisfactorily, especially with large coils. It is desirable that the alternating dynamo, where one is used especially for coil work, be specially designed for the purpose. We have no knowledge of anything in print giving information on just the points you mention, and we therefore will have an article prepared in which this information will be fully treated.
